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EUGENICS

BY
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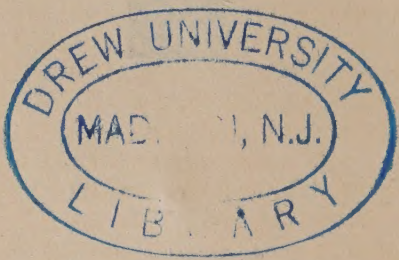

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PREFACE

To write a short book on Eugenics is not an easy task. It is difficult to decide how much space to devote to heredity and purely biological problems. Since it may be supposed that few readers will have any considerable biological knowledge, it would be necessary, if such matters were not dealt with, to say at the outset that readers without such equipment must be advised to read some biological text-book before going further. Such readers might in that case complain with some show of justice that the treatment of a subject in this series should be complete in itself, even if elementary. Thus some reference to the biological background is inevitable, though it can hardly be hoped that a brief and condensed treatment will be fully understood by readers hitherto unacquainted with these subjects. They must be requested to amplify what is said here by reading one or more of the books mentioned at the end of this volume. On the other hand, those biologists who chance to read this book will certainly feel inclined to quarrel with the over-simplification of the facts and the dog-

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matic nature of the treatment which compression renders it impossible to avoid. Other difficulties are not less obvious. There is as yet in this field no large accumulation of data, and therefore when conclusions came to be drawn we often found ourselves moving in a region of much uncertainty. It is of the utmost importance that the conclusions should not be made more definite than the evidence warrants, however vague and unsatisfactory the treatment of important problems may seem as a consequence. The fact that the conclusions have an intimate and important bearing upon social problems of interest to all only adds to the difficulty of the task.

I have to thank Mr. R. A. Fisher, Mr. D. Caradoc Jones, and Professor Julian Huxley, who have read the proofs, for valuable suggestions.

A. M. C.-S.

The University,
Liverpool.
December, 1925.

CONTENTS

CHAPTER		PAGE
I.	THE SCOPE OF EUGENICS . . .	9
II.	THE MECHANISM OF INHERITANCE .	29
III.	INHERITANCE IN MAN	51
IV.	ENVIRONMENT AND INHERITANCE .	76
V.	HEREDITY AND ACHIEVEMENT . .	109
VI.	THE DISTRIBUTION OF INHERITED QUALITIES	118
VII.	THE DISTRIBUTION OF INHERITED QUALITIES (*continued*)	142
VIII.	RACIAL CHANGES AND THEIR CAUSES .	165
IX.	RACIAL CHANGES AND THEIR CONSEQUENCES	199
X.	THE CONTROL OF RACIAL CHANGE . .	224
	NOTES ON BOOKS	253
	INDEX	255

EUGENICS

CHAPTER I

THE SCOPE OF EUGENICS

"Do men gather grapes of thorns or figs of thistles?" This is one of those questions to which no answer is expected. Everyone knows that grapes are only to be gathered from vines, and figs from fig trees. Let us explore a little further into this knowledge which is common to everyone. It is clear that vines, fig trees, thorns and thistles are different kinds of plants and that they maintain their distinctive characters. These characters are somehow present in the seed. If we wish to raise a specimen of any one kind of plant we must sow the seed of that plant; similarly if we wish to add to our stock of any one kind of bird we must arrange for the eggs of that bird to be incubated. If geese are required it is useless to incubate the eggs of turkeys, and if vines are required it is useless to sow the seeds of thorns. The seeds of the various kinds of plants and the eggs of

the various kinds of animals are somehow different. It is thus common knowledge that at least in a certain sense and up to a given point the peculiar nature of any given seed or egg determines the structure and characteristics of the organism which develops from it.

It is also clear that the existence of a seed or of an egg does not absolutely determine that a given organism shall emerge from it. Seeds will not grow unless there is a certain amount of warmth, of moisture, and in later stages, of food. So too animals only develop from eggs under appropriate environmental conditions. Unless for the whole of the twenty-one days during which a hen's egg must be incubated it is kept within a certain narrow range of temperature it will die. An appropriate environment must thus play upon eggs and seeds if they are to develop, and an appropriate environment is thus as necessary for the production of an adult as is the living substance upon which it acts. This living substance is derived or inherited from the parents. Among the higher animals the female contributes the egg while the male contributes the spermatozoon. The spermatozoon penetrates the egg and fuses with it. The egg is then said to be fertilised, and the fertilised egg is thus the product of the fusion of the male and female contributions. The adult, therefore, arises as the result of the

play of the environment upon the inherited basis. It is obvious that both an inherited basis and appropriate environmental conditions are necessary.

The relative importance of these two factors has caused much discussion. Calling the inherited basis "nature" and the environment "nurture," there has been and still is considerable controversy as to which is the more potent. That controversy will call for detailed attention in a later chapter. If, however, we now continue as before and on the basis of knowledge familiar to us we consider this problem further, it soon appears that more is known about the part played by "nature" than appears at first sight. It may be asked, for instance, whether the influence of "nature" goes further than to determine the general outline of the structure of organisms. Does "nature" merely determine that a man and not an ape shall develop from the egg, or does its influence go further and determine some at least of the differences which exist between men? Experience common to us all tells us that some at least of the characteristics which distinguish one man from another are due to nature and not to nurture. Men, for instance, differ from one another in respect of the colour of their eyes. It is well known that it is not possible to change the colour of a child's eyes by subjecting it to any particular kind of

upbringing. Eye colour is independent of the surroundings. It follows that, if the differences between men in respect of eye colour are not due to differences in the surroundings to which they have been subjected, they must be due to differences in the inherited basis with which they began life.

The knowledge we have of the differences between members of the same family points unmistakably in the same direction. It can very seldom, if ever, be the case that two members of the same family, even if they are twins, have precisely the same upbringing. But members of the same family more often than not grow up under a very similar environment. They grow up in the same house; they have much the same food; they come in contact with much the same people. Nevertheless, members of the same family differ profoundly from one another. One may be tall and another short, one robust and another ailing, one gifted with musical talent and another with manual dexterity. These striking differences between members of the same family, which are so familiar, cannot be in the main due to any differences in the treatments respectively received. They must be chiefly due to differences between the hereditary equipments with which their possessors respectively started life. It will be necessary to consider later how it comes about that offspring of the same parents can have different

hereditary equipments; the only matter that concerns us at the moment is that they do have different equipments, and that these inherited differences account for many of the differences that we observe between brothers and sisters.

It would be possible to go further and extract from the knowledge which is common to us all more conclusions as to the part played by inheritance. It is enough, however, for our present purpose to have shown that inheritance is in part at least responsible for the differences which exist between men. If it was the case that inheritance merely laid the ground plan of human structure, and that all differences between men were due to differences in the environment, inheritance would be of little immediate account in human affairs. But this is not so, and it is thus evident that inheritance has no small bearing upon human problems. It is the object of this book to study the part played by inheritance in human affairs.

The study of inheritance among animals and plants, including man among the former, is a special branch of biology. It may, in fact, be regarded as a separate science. This study has two aspects. It is possible to study the mechanism of inheritance, and it will be shown in the next chapter that the mechanism is apparently similar in all organisms, man not excepted. It is also possible to study the

factors in each species which are inherited by means of this mechanism. Clearly there are different factors in each species. Cattle must have factors for horns, hoofs and tails that men do not possess. Since we are interested in the importance of inheritance in human affairs we are interested not only in the mechanism of inheritance, but also in the factors carried by man and transmitted from generation to generation.

We are interested, therefore, in the results reached by students of this science. How far do these results enable us to understand the part played by inheritance in human affairs? The student of inheritance is going to tell us what innate factors man possesses and how they are transmitted from generation to generation. A little reflection will show that in order to be able to solve our problem we must have information additional to that which the student of inheritance is going to provide. It is not enough to know that there are within the human species certain innate qualities which are inherited in a particular manner.

Let us suppose that students of inheritance told us that there are certain factors governing height and that they are inherited in a particular fashion. We should next ask how far different environmental conditions can influence height. The following question might be put. If two men inherit the same

factors for height, what difference will it make if one is brought up in good and the other in bad surroundings? This and similar questions are problems in general biology, and it is evident that the information supplied by students of inheritance must be supplemented by information derived from students of general biology. Knowledge is required as to the moulding power of such aspects of the physical environment as food, moisture, light and temperature.

It is also necessary to have information regarding the moulding power of the social environment upon mental characters, and for the same reasons. Students of inheritance may tell us that certain factors inherited in a particular fashion determine temperament. It is necessary to gain some idea as to the degree to which temperamental characteristics are moulded by different social conditions. If of two men, equally self-assertive by nature, one lives under a repressive régime while the other is encouraged to assert himself, how far will they come to differ? Such problems do not fall within the scope of biology, but rather within that of social psychology, and information is thus also required from students of that branch of scientific inquiry.

When, however, all available information has been gathered from these sources, it is plain enough that we shall not yet be in a position to assess the importance of inherit-

ance in human affairs. The kind of question to which an answer is required by those who are concerned with this problem is whether the different groups of mankind, the negroes and the white men, for instance, or the different classes within the same racial group, the professional and the manual labour classes in this country, for example, differ in respect of their inherited qualities, and, if that is so, how far the different achievements of the different groups and classes are due to innate differences. To answer such questions it is necessary to know not only what inherited qualities there are and how they are inherited, but also how the inherited qualities are distributed in the population.

A special field of study is here disclosed which does not fall within the scope of any of the sciences mentioned above. With the results of such a study before us it would be possible to go some considerable way towards finding a solution to our problem; it would be possible, for example, to estimate the part played by inheritance in the formation of the pauper or the criminal class. But this information would not enable us wholly to solve our problem. We want to understand not only the part played by inheritance at the moment, but also in past times. Furthermore, since human society is not static, it is, in fact, scarcely possible to consider the importance of inheritance in human affairs at any one

moment. The part played by inheritance is changing from hour to hour. Some thousands of deaths occur every hour in the world as a whole, and the thousands of births which take place during the same hour do not see the entry into the world of persons bearing the same hereditary qualities as those who have just passed out. This element in the situation cannot be left out of account if we are making any comprehensive investigation into the importance of heredity at the present time. Let us take the case of the mentally deficient as an example. We want not only to know how the factors underlying mental deficiency are distributed in the population, but also whether these factors are becoming relatively more numerous. Another special field of inquiry thus opens out, an inquiry into the nature and extent of the changes in the innate constitution of the human race which have taken place and are now taking place.

In order, therefore, to solve the problem as to the part played by inheritance in human affairs, it is necessary first to take such information as is relevant to our purpose that has been accumulated by students of inheritance, of biology and of social psychology. Secondly, it is necessary to make special studies as to the distribution of inherited qualities and as to the changes in the inherited or germinal constitution of the human race.

From this two conclusions follow. Eugenics is a science. There is a special field of data which can be made the subject of accurate observation and measurement in a detached frame of mind. Further, the science of eugenics stands upon the shoulders of other sciences. In this eugenics is not peculiar among the sciences. The psychologist, for example, studies the functions of the animal body. To understand them, however, he must make himself acquainted with the results arrived at by chemists and physicists. Physiology thus stands upon the shoulders of physics and chemistry much as eugenics does upon the shoulders of the sciences mentioned.

It may very likely seem that the science of eugenics as outlined here has but little to do with what is commonly understood to constitute eugenics. The word eugenics calls to mind proposals for getting rid of persons with undesirable innate qualities and for encouraging the bringing into the world of well-endowed children. It is regarded as one of the many proposals put before the public having social improvement as their object, and thus tends to be classed with co-partnership, profit-sharing, the taxation of land values and many similar schemes. The word eugenics is, in fact, commonly taken to mean applied eugenics and that only. The existence of a science of eugenics is seldom recog-

nised. For this the public is not to blame, as will appear shortly when we come to glance at the history of eugenics. It is, however, of primary importance that the nature, scope, importance and relation of the science of eugenics to applied eugenics should be understood.

Of the nature and scope of the science of eugenics enough has been said for the moment. What of its importance and relation to eugenics as ordinarily understood? Applied eugenics has as its aim the improvement of racial qualities. Those who make eugenic proposals desire that heredity shall play a part in the future different from, and superior to, that now played. The relation of the science of eugenics to applied eugenics is thus obvious. Unless we understand the part played by heredity now we cannot hope to be able to frame proposals as a result of which it will play a more satisfactory part in future. Take any eugenic proposal. Suppose that it is desired to increase the amount of ability in the population. We must know how ability manifests itself; otherwise it cannot be recognised. We must know in what section of the population it is to be found and what reactions different social forces and surroundings have upon those possessing ability so far as their contributions to future generations are concerned. Without such knowledge sound proposals cannot be made, and it

is just such knowledge that the science of eugenics sets out to provide. The relation of the science of eugenics to applied eugenics is thus neither obscure nor remote.

While these relations are obvious and intimate, the distinction between them must never be forgotten. Within a pure science there is no room for differences of opinion such as are always appearing in the realm of an applied science. Within a pure science opinions may differ because men may disagree as to whether enough observations have been taken and as to whether they are accurate. In the realm of the science of eugenics there is room for disagreements of this kind only. As the science is young and the subject matter difficult, the knowledge definitely secured is small in amount. But in time as observations accumulate there is less and less room for disagreement, and sooner or later universal assent is obtained to a certain number of propositions. Within the field of applied eugenics there is room for differences of quite another nature. Even if we understood all that we wanted to know as to the part played by inheritance, we might not agree as to which qualities were the most desirable to encourage and as to which methods it would be best to employ. Sterilisation is a method warmly advocated by some, whereas it is repugnant to others. Some men value one quality highly, others another. The use to

be made of the knowledge accumulated by students of the science of eugenics is thus a controversial matter and will always remain so. But applied eugenics is not peculiar among applied sciences in this respect. Medical science will establish in time exactly what results follow vaccination. Men, however, differ and may continue to differ in the views they take as to the use to be made of this knowledge, some holding that it is "unclean" and "contrary to nature," others holding that it is a welcome advance in scientific knowledge of which every use should be made.

Let us, however, keep the distinction between the science of eugenics and applied eugenics clearly in mind. Unless arbitrary limits are to be set to the use of human intelligence, the former is a proper subject for inquiry. The inquiry may be pursued as an end in itself, as is the case with any other science, without any regard to the use which may be made of the results achieved. So far as its results are debatable they are fit only to be debated by those with some scientific knowledge. The layman is out of his depth in a discussion of the chemical constitution of poisonous gases; he can legitimately enter into the discussion as to whether such gases may be used in warfare. The same holds good of eugenics. An understanding of this simple point would have made impossible

many foolish attacks upon eugenics as a whole. It is as foolish to ridicule the science of eugenics because certain proposals to improve the inherited qualities of the race are disliked, as it would be to ridicule the science of chemistry because the use of poisonous gas in warfare does not meet with favour.

A glance at the history of eugenics shows that the failure to grasp this distinction is due rather to the expert than to the layman. It was, of course, impossible for the science of eugenics to arise until recently. It stands upon the shoulders of other sciences which until recent years had not been developed. But the idea that the human race might be improved if judgment was exercised in mating arose long ago. All writers on eugenics quote from the Greek poet Theognis, who lived in the sixth century B.C. Their example may be followed here. "We look," he says, "for rams and asses and stallions of good stock, and one believes that good will come from good; yet a good man minds not to wed the evil daughter of an evil sire if he but give her much wealth." Long ago in the early days of the domestication of animals men must have observed that in order to raise good stock it was necessary to select the better animals for breeding. They did not fail to see that the same applies to the human race, though they seldom attempted to put

this knowledge into practice. Thus Plutarch tells us that the laws of other nations seemed absurd and inconsistent to Lycurgus, the Spartan legislator, because, while they aimed at securing domestic animals of good stock, they did nothing to secure a good native endowment for their citizens. It is said that in Sparta under the influence of Lycurgus attempts were made by law to promote desirable marriages and to discourage undesirable unions. But such attempts have been rare.

Rare as such measures have been, references to the desirability of such measures are not uncommon, especially in the literature which sketches an ideal state of human society. To take two examples; the necessity of arrangements to secure a good inheritance for the citizens of his ideal society was very apparent to Plato. The best of both sexes were to be brought together as often as possible, and regard was to be had to the age and other characteristics of parents in such manner as to promote the production of the best-endowed children. Again, when, some two thousand years later, Campanella sketched his ideal commonwealth, he laid stress upon the desirability of regulating marriage in the interests both of the children themselves and of society.

Thus the idea that human reproduction might be controlled in order to benefit the

species dates from long ago. To Sir Francis Galton, who coined the word eugenics, is due the credit of having brought the idea prominently to notice in recent times. As the result of his work, not only has the idea become part of the mental heritage of all educated people to-day, but also the science of eugenics has taken definite shape. Sir Francis Galton (born 1822, died 1911) was a cousin of Charles Darwin. His early years were spent in exploration and travel. The later years of his long life were devoted to the advancement of science. He was a pioneer in more than one field, but it is his work in the field of eugenics which is of special interest to us. In 1865, six years after the publication of the *Origin of Species*, Galton referred for the first time to the problem of human racial improvement; four years later, when he was nearly fifty, he published *Hereditary Genius, its Laws and Consequences*. It was not, however, until 1883 that in his book *Human Faculty* the word "eugenics" was first employed. The word has for some decades now been accepted in the country of its origin and has passed into more than one foreign language. Galton's work fell on fruitful ground. Why was the ground, it may be asked, so well prepared for the reception of his ideas?

In the first place, very great success had been achieved by breeders of farm stock in

their efforts to improve farm animals during the preceding hundred years, and no less success had followed the efforts of horticulturists. There were thus abundant examples which Darwin used in another connection to which to point in order to show what might be effected by controlled breeding. Again, about that time men were beginning to recognise that human problems were susceptible of treatment by scientific methods. Formerly science had dealt chiefly with matters remote from human interests. At the date when Galton first turned his attention to eugenics the popularity of works attempting to give scientific explanations of historical events shows that the outlook of men was changing. Far more important, however, was the influence of Darwin. Before the publication of the *Origin of Species* in 1869, not only laymen but also nearly all experts favoured the view that species were fixed, that there were then as many species as there had been in the beginning. It is evident that so long as such views held the field it was difficult if not impossible to grasp the fact that the human or any other species might undergo considerable change, beneficial or otherwise. But as soon as men came to believe that highly organised species had evolved from primitive types by the operation of natural selection, they were prepared to believe that equal, if not greater, changes might result from deliberate

selection. Darwin's work showed men that their own racial improvement was an end for which it was possible to strive. The growing tendency to use scientific knowledge in order to cope with social problems inclined men to think that such efforts were desirable.

While little has yet been done in any part of the world by way of legislation deliberately to promote racial improvement, it is true to say that, when social problems are under consideration in any civilised country, the possible importance of heredity is seldom left out of account. The question, for instance, is now often asked whether the chronic pauper and the habitual criminal are not what they are owing in some measure at least to their possession of peculiar inherited qualities. Research is being actively pursued in many countries. Under the terms of Sir Francis Galton's will a chair of Eugenics was founded at University College, London, and is now held by Professor Karl Pearson. It is now worth noting how Galton defined eugenics and how, partly as a result of the form that this definition took, there is at present no general recognition of the fundamental distinction between the science of eugenics and applied eugenics.

The latest definition of eugenics given by Galton runs as follows: "Eugenics is the study of agencies under social control which may improve or impair the racial qualities of

future generations either physically or mentally." It is not worth while quoting his earlier definitions. They all contain essentially the same features. They all fail to make clear whether he is thinking of eugenics as science or as an art. The above definition is in form that of a pure science. But since it introduces the words "improve or impair" it is not, in fact, a definition of a pure science. In order to decide whether any agency is improving or impairing racial qualities, it is necessary to introduce judgments of value and to decide what is good and what is bad. With good and bad a pure science has nothing to do; it is concerned only with what is. The same confusion, for which the best known followers of Galton have a share of responsibility, is still everywhere apparent. Thus the Oxford Dictionary defines the adjective eugenic as follows: "of the production of fine (especially human) offspring"; the noun eugenics is defined as "the science of this." Etymologically this is a correct definition, but viewed thus eugenics is wholly an applied science. It is not surprising that the public is confused as to the nature and scope of eugenics.

The view taken in this book has already been sufficiently explained. The science of eugenics is the study of the part played by inheritance in human affairs. When the knowledge so gained is used to improve

racial qualities, we may speak of applied eugenics. In the next eight chapters of this book we shall be concerned with the science of eugenics. In the tenth chapter some matters connected with the application of this scientific knowledge to problems of the day will be discussed. Emphasis is thus laid in this book upon the science rather than upon the art of eugenics. If proposals for reform are to be of any value, they must be based upon accurate knowledge. There is no space here for adequate consideration both of the scientific and the applied side of eugenics; furthermore, practical proposals are widely discussed in current literature. Therefore our attention can be most profitably devoted here to the scientific aspect.

CHAPTER II

THE MECHANISM OF INHERITANCE

Little more than twenty years ago the study of inheritance was in its infancy. It was evident that like tends to produce like, that children tend to resemble their parents, that children of the same parents tend to resemble one another. So much was common knowledge in the days of Theognis, more than two thousand years ago, and had then no doubt been common knowledge for thousands of years previously. But until very recently nothing was known of the mechanism of inheritance, and there was thus no explanation of the apparent vagaries of inheritance. Like tended to produce like in the long run, but any particular child might closely resemble one or other parent or some remote ancestor or it might exhibit some wholly novel characteristic. There was no rational explanation of these well-known facts.

Early in the present century students of this problem began energetically to follow up a clue which had been discovered by an Austrian monk of the name of Mendel more

than thirty years before. The neglect of this clue to the solution of a most important problem of the widest possible interest for so many years is one of the most curious incidents in the history of modern biology. In the last twenty-five years, however, students of heredity in every civilised country have been at work using the key discovered by Mendel, and have accumulated a vast amount of information. One very distinguished worker in this field, reviewing the results achieved, has recently said that the problem of heredity has now been solved. By this he means that the essential features of the mechanism of heredity are now understood, and that the same mechanism is at work throughout the animal and vegetable kingdoms. He does not claim, it should be clearly understood, that the factors or genes borne by each species have been investigated; it will be apparent, for example, that little as yet is known regarding the genes carried by the human species. He only claims that the essential features regarding the mechanism which controls the behaviour of the genes in any species is now understood. While this claim is not fully admitted by all authorities, there is a very large measure of support for it.

An adequate description of this mechanism accompanied by the evidence upon which it is founded could not be given within the

limits of this book. Something, however, must be said. A very brief outline of some of the more important aspects which are relevant to our particular problem must be attempted. Such an outline cannot help being dogmatic in form where dogmatism is very much out of place. The reader must be requested to supplement what is said here and to use one of the many full and adequate reviews of this subject which are now available.

Our knowledge of the mechanism of heredity is built both upon direct observation of the reproductive process and upon deductions drawn from the results of breeding experiments. Observation shows that all organisms originate from other organisms. These other organisms, or parent organisms, may divide into small pieces from each of which a new adult may develop; they may grow a bud and the bud may separate from the parent organism and become a new adult. In addition to these methods of reproduction, which may or may not obtain in any given species, another method occurs at one time or other in the life history of almost every species. It is the only method that obtains among the higher animals, and is therefore the only method that we need take into account.

This third method is that of sexual reproduction. It consists in the fusion of a cell

given off by the male parent with a cell given off by the female parent. The bodies of the parents are built up of millions of cells, and the cells which are given off are merely cells of a somewhat peculiar nature, on which account they are often called germ cells or gametes. Every cell consists of a drop of living matter which at the edge of the drop is more dense than elsewhere and forms the wall of the cell. Within each cell there is a central body or nucleus. Male germ cells and female germ cells are single cells each with a nucleus. Male germ cells, or sperms, are much smaller than female germ cells, or eggs, and the process of fusion, which is the essential feature of sexual reproduction, consists in the penetration of a sperm into an egg and in the fusion of the nucleus of the sperm with that of the egg. The single cell resulting from the fusion of two gametes is known as a zygote.

These facts have been known for a number of years. It has long been apparent that somehow or another this physical continuity of parent with offspring just described explains the tendency of like to produce like. The more detailed and accurate our observations can be made as to the structure of the gametes and as to what occurs during their fusion, the more likely are we to be able to understand the phenomena of inheritance. Within recent years more refined methods of

observation have enabled us to make further advances in our knowledge of this process.

It can now be seen that every nucleus contains within it a number of rods called chromosomes. With the important exception of the germ cells, to which reference is made later, there is normally the same number of rods in every cell of every member of a species. The rods or chromosomes are normally in pairs, and the total number of chromosomes is thus normally an even number. The chromosomes are not always visible; they sometimes seem to go into solution. Before division of the cell takes place, the chromosomes reappear and each chromosome divides lengthways into two, and each of the cells resulting from the division receives half of each split chromosome. It thus results that every cell in the body, since they are all formed by division from previously existing cells, contains the same number of pairs of chromosomes. The chromosomes do not continually diminish in size owing to this process, because the halves into which the chromosomes split subsequently grow to the size of the original chromosome.

The germ cells, however, differ from the other cells in that they have only half that number of chromosomes which is characteristic of the species. Thus while the ordinary body cell of man has twenty-four pairs of chromosomes, forty-eight in all, the eggs and

sperm have twenty-four in all. But these twenty-four are not in pairs. They represent one chromosome of each pair. When a human sperm fuses with a human egg the resulting zygote contains forty-eight chromosomes or twenty-four pairs, one member of each pair having been introduced by each parent. Thus sexual reproduction does not result in the doubling of the number of chromosomes because the gametes which fuse only contain one member of each pair.

This is as far as direct observation will carry us. There is here a mechanism as the result of the working of which every new member of the species receives one chromosome of each pair from each parent, and every cell in the body of the new individual receives the same number of pairs. The chromosomes are clearly very important; otherwise there would not be this remarkable mechanism for their exact distribution. They are the only contributions made equally by both parents. The facts so far disclosed thus suggest that the chromosomes are the bearers of inherited qualities. This supposition is confirmed by the deductions drawn from the results of breeding experiments to which we must now turn.

It is wholly impossible to attempt here any explanation as to how it is that we are led to make deductions from the results of breeding experiments regarding the invisible structure

of the chromosomes. It may be remembered that physicists have been able in a somewhat similar manner recently to make deductions from their experiments as to the equally invisible structure of atoms. The picture that we are led to construct is as follows. The chromosomes contain a large number of particles called genes. These genes are arranged in a single row. We might picture the chromosomes as cords and the genes as knots in the cord. There is reason to think that the genes are the actual bearers of the inherited qualities which may be regarded as somehow embedded in the chromosomes.

A more illuminating picture may be formed by likening the chromosomes to rods with a large number of slots into each of which fits a gene. Each member of a pair of chromosomes has an equal number of slots. Further, the corresponding slots contain genes controlling the same character. It may be, for instance, that the fiftieth slot in each member of the second pair of chromosomes is the receptacle for the gene controlling the colour of the eye. There are, therefore, at least two genes controlling each character, one in one member of a pair of chromosomes and the other in the corresponding member. Since each member of a pair of chromosomes is derived from a different parent, it follows that each member of a pair of corresponding genes is derived from a different parent, one,

in fact, from the father and the other from the mother.

It may be the case that a visible character-difference is controlled by a single pair of genes or it may be that such a character is controlled by more than one pair of genes. Let us suppose that a character is controlled by three pairs of genes; in that case there are six genes involved, three of which are derived from the father and three from the mother. Or it may be that a character we select for examination is only one of the characters controlled by a single pair of genes. These differences are of no immediate importance. The important fact deduced from the evidence referred to is that all characters, mental and physical, are controlled by genes in pairs, one member of each of which is provided by the father and the other by the mother.

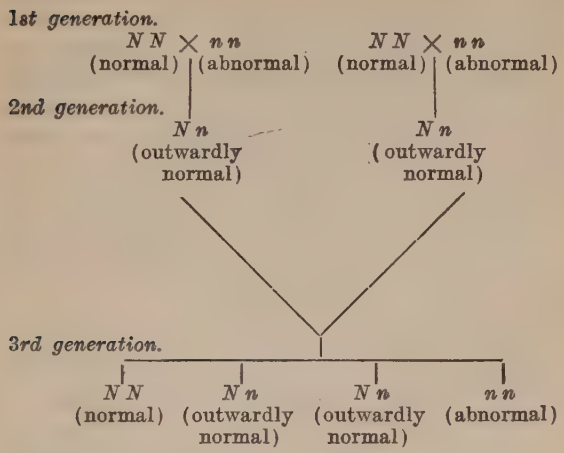
Keeping in mind these details as to the mechanism of inheritance, it is possible to answer, with the addition of but a few other facts, some interesting and important questions. The following problems may be selected for examination. How does it come about that children are not a mere half-way blend of their parents, that children of the same parents differ from one another, and that children sometimes resemble their grandparents and more remote ancestors rather than their parents? Let us begin with the first question. If characters are governed

by genes of which an equal number is always derived from each parent, it might seem the children ought to exhibit a blend of the characters shown by the parents. This is not so for the following reason among others. When one parent contributes a gene which is different from that contributed by the other parent, the character exhibited by the child in most cases is wholly governed by one of the two genes. The governing gene is said to be "dominant" over the other gene, which is said to be "recessive." Thus there is apparently a type of mental deficiency which is governed by a single pair of genes. These genes are of two different types. The first produces the normal mental condition and may be called *N*. The other produces the mentally deficient condition and may be called *n*. A person carrying two *Ns* will be normal (and it will be recollected that everyone carries at least two genes of each kind, but can only give one gene to each child), while a person carrying two *ns* will be abnormal. Suppose that two such persons marry. The first must give *N* to each child and the second must give *n*. Each child will carry one *N* and one *n*, and each child will to all appearance be quite normal, because *N* is dominant over *n*.

There is no blending in respect of this character. Similarly there is no blending in the case of any other character governed by a

single pair of genes one of which is dominant over the other and contributed by one parent, while the other parent contributes a recessive gene. When, in the case of a human character, such as height, which is probably controlled by many pairs of genes, each parent contributes some dominant genes, an apparent blending may arise. But the mechanism of inheritance being what it is, it is not difficult to understand why, even though children receive one member of every pair of genes from each parent, they are not invariably mere half-way blends of their parents' characteristics.

If we follow an imaginary family history of one of the children resulting from such a marriage as that mentioned above, it will illustrate the answers to some other problems. Let us suppose that one of these outwardly normal children marries someone with a similar ancestry. Both father and mother will be carrying *Nn*. A parent can only give one gene to each child, and it is a matter of chance which gene is given in any particular case. It follows that each parent will on the average give *N* to half the children and *n* to the other half. A little reflection will show that on the average, out of every four children one will receive two *Ns*, one two *ns*, and two will receive one *N* and one *n* each. The history of the three generations may be written as follows:



Consider the third generation. The four children of the same parents are not alike in respect of their mental characteristics. One is outwardly abnormal or mentally deficient, while of the remaining three, two, though outwardly normal, carry a gene for abnormality. Again, the abnormal child belongs to a type not represented in the parental generation but found in the grandparental generation. In the language formerly used in this connection it has "reverted" to an ancestral type. In this manner "reversion" and other not uncommon and to the general public not unfamiliar occurrences can now

be understood, whereas twenty years ago, when the mechanism of inheritance had not been discovered, there was no rational explanation of them. It can now be understood how it comes about that although the characters of the children are conditioned by genes which are derived from, and were actually present in, the bodies of the parents, the children are neither the same as their parents nor similar to one another. It is again obvious why in the long run like tends to produce like.

Very simple examples have been chosen. It is necessary to remember that the conditions may be and usually are very complicated. There are usually many slots in each chromosome and several pairs of chromosomes. Suppose that there are two kinds of gene for each pair of slots, *A* and *a* for the first pair of slots, *B* and *b* for the second pair, and so on. It is clear that in a species so constituted a very large number of different types of individual may appear. One may carry *AA*, *BB*, *CC*, another *Aa*, *Bb*, *Cc*, another *AA*, *Bb*, *cc*. It is evident that on this assumption, when the fact that there may be thousands of pairs of slots is taken into account, the number of different possible types of person is very large indeed. But this is not the only source of complication. There may be several different kinds of gene fitting into a pair of slots. There may be *A*, *A*1, *A*2, *A*3, *A*4, *A*5,

*A*6, and more. In respect of this pair of slots alone an individual may be *A A*3, *A*2 *A*4, *A*1 *A*6, or may assume many other possible conditions. The total possible number of different kinds of individual in such a species is almost infinite. It is no wonder that two persons (the so-called identical twins apart, about whom more is said in the next chapter) are seldom if ever alike in respect of their innate endowments.

It is now possible to understand how improvement or deterioration in any character may be brought about by selection. Let us suppose that mental deficiency is caused by a recessive gene, *n*, and that it is desired to rid the population of mentally deficient persons. Mentally deficient persons, those carrying two *ns*, will not be allowed to reproduce. Outwardly normal persons alone will be permitted to have children. But, while some of the latter will be *NN*, others will be *Nn*. From time to time a person carrying *Nn* will marry another also carrying *Nn*, and some of their children will carry two *ns*. Such children will not be allowed to reproduce and in course of time the *ns* will be lost from the genetic constitution of the population. All will carry two *Ns*.

Selection becomes far more complicated when the character selected is governed by many alternative genes or by more than one pair of genes. But the important fact remains

that our efforts are directed to producing a strain which is pure for the best of the alternative genes offered to us. To achieve our aim we attempt to select persons who carry particular genes to be the parents of future generations. Selection is a process of sifting. We attempt to construct a sieve of such a nature that those persons who are caught and preserved are those who carry the more desirable genes and become the parents of future generations, whereas those who do pass through are rejected. Artificial selection is a process of precisely the same nature as natural selection. Among animals and plants in a state of nature the conditions are frequently such that a certain type within a species, it may be the tallest members of the species, are favoured and become the parents of future generations, whereas the shorter are eliminated. These taller specimens are selected, or, as we may say, sifted out. In consequence racial change, that is to say, evolution, occurs. We may judge the change which occurs to be either good or bad and may thus speak of progress or of degeneration as happening under natural conditions. Artificial selection differs from natural selection only in that it is directed to bringing about changes that are judged to be improvements. The method is the same and the amount of change that the sifting can bring about is limited to the number and characteristics of

the alternative genes in existence at any given time.

These considerations bring us to the heart of that side of our problem which is connected with the part played by racial changes in human affairs in the past and the part which may be played in future. Selection can only operate upon the material presented to it. So far as we know, selection has no influence upon the nature of this material in the sense that it causes any new genes to come into existence. Since it is impossible to suppose that the genes now carried by man were present in the primitive forms of life from which he has evolved, and have been merely sorted out in the course of ages, it follows that new genes must have come into existence. The position is therefore in need of further explanation. How do new genes come into existence? How are additions made to the material upon which selection works? Without such additions the effect that selection can produce must be limited.

One explanation is that genes which were not present in the parents sometimes appear in the offspring. They seem to arise by the transformation of pre-existing genes. Existing genes sometimes "mutate." To take an imaginary case. Let us suppose that for one pair of slots there are six alternative genes, *A*1 to *A*6, which determine height. A new gene might appear at either end of the series.

We might find an individual with a gene determining a height greater than that to which the possession of *A*1 predisposes its possessor or less than that to which *A*5 predisposes the individual which carries it. Nothing is known as to the nature of the change which occurs. But we can form a picture. It is well known that the element sulphur exists in several different forms; there are various crystalline varieties as well as amorphous varieties. These varieties arise owing to some modification of the molecular structure which can be induced by subjecting sulphur to particular conditions. Subjected to these conditions the internal structure is modified and the appearance and properties of the sulphur are changed. Such facts enable us to realise that under appropriate influences the internal structure of a gene might change, and that just as there are several varieties of sulphur each with different properties, so there may be several varieties of a type of gene each with different properties.

Nothing is known as to the nature of mutations. Very little is known as to the cause of mutations. There is evidence that animals subjected to X-rays or treated by other violent methods may subsequently bear offspring which exhibit certain defects, and that these defects are inherited by later generations. It is thus apparently possible to induce mutations by violent methods, but

such experiments shed no light upon the causes of mutation under natural conditions, where parents are not subjected to X-rays and similar violent stimuli. The statement that we are at present ignorant of the cause of mutations under normal conditions must not be taken to imply a belief that mutations are "spontaneous." This misunderstanding, common as it is, is wholly without excuse.

The unavoidably dogmatic statements made in the above paragraph imply that a certain point of view is here taken up regarding the familiar problem of the inheritance of acquired characters. The belief in the inheritance of acquired characters takes many different forms. They all have this in common; it is believed that particular experiences to which the parents have been subjected may modify the parental genes in such a manner that the offspring receive a complement of genes somewhat different from that which they would have received had the parents not had these experiences. The view, for instance, was advocated by Lamarck, accepted by Darwin and is still held in some quarters, that the use or disuse of parental organs modifies the parental germ cells. If the parents do not use their eyes, not only may their eyes degenerate, but the genes for eye development transmitted to the offspring may be in consequence affected in such a manner that the offspring will have less good eyes than they

would otherwise have had. Those who hold such views believe that something is known as to the cause of mutations.

The view taken in this book, which is that now held by the great majority of biologists, is not that the experiences normally undergone by the parents cannot influence the germ cells of the parents, and therefore the innate endowment of the offspring, but that no instances of any such thing are known. The distinction is important. Mutations occur; something must cause them, and the causes may ultimately have to be sought in the experiences of the parents. But a very large number of cases have been investigated in which it was supposed that the experiences of the parents other than the violent experiences referred to above had induced changes in their germ cells, and in no case has it been established such changes were produced. So large is the number of these cases that we can say that certain classes of experience do not induce changes. Not only is there no reason to believe, but there is reason not to believe, that education of the parents enhances the innate ability of the children and that good and bad surroundings experienced by the parents respectively increase and diminish the innate physical development of the children. In other words, modifications induced in the parents by their experiences have not been found to produce such modifications in their germ cells as will cause the offspring to be

born with an innate tendency to exhibit characteristics similar to the modifications of the parents. It may be, but it has never been proved, that these experiences of the parents induce germinal changes affecting quite different characters. Thus it seems clear that, while slum life may stunt the parents, it does not induce changes in their germ cells causing their children to be smaller than they would otherwise have been. But it is possible that the experiences summed up in the term slum life may induce other changes; they might, for example, produce such germinal changes as would cause the children to be born with hair of a colour other than that which they would have had except for the slum life of their parents. Such cases, however, have never been definitely established.

The matter may be summed up by saying that it is not possible to relate any normal experiences of parents to mutations in their germ cells, and that certain experiences commonly undergone by particular sections of the population seem definitely not to be related to changes in the germ cells analogous to the modifications induced by the experiences. From this very important conclusions follow. Artificial selection can make the best of the material present in the germ plasm of the race. Further advance must wait upon the appearance of favourable mutations which in the present state of our knowledge we

cannot hasten. On the other hand, deterioration may occur if those bearing the desirable genes fail to reproduce. The desirable genes may thus be lost. But unless unfavourable mutations occur, deterioration can go no further than the point at which only the undesirable genes remain.

The matter may be put in this way. Those who aim at racial improvement, who desire to build up a better-endowed race, have a certain number of bricks of a certain number of different kinds at their disposal. The most they can do is to select the bricks which best suit their purposes. They cannot make new bricks. Sometimes bricks of a new kind appear in the heap and, if the new bricks are more suitable than existing kinds of brick, they can be seized upon and employed. Upon the appearance of new bricks depends the ability to improve the race beyond the point which would be reached by using the most suitable combination of the best bricks now in existence. To learn the secret of making new bricks at will would be to make a more revolutionary scientific discovery than has ever yet been achieved. It would then be possible to build up a race much as we pleased, whereas at present we are hampered by the limitations imposed upon us by our material.

We are here studying the part played by inheritance in human affairs with the object of applying the knowledge so gained to bring

about human racial improvement. Of what importance to us are these modern discoveries regarding the mechanism of inheritance? Before these discoveries were made it was known that like tends to produce like. That remains as the fundamental fact of importance which governs the situation. But our knowledge has been greatly amplified in various directions which are of no little importance. (1) Such apparent vagaries as "reversion" to ancestral characters are now understood. These and other phenomena, formerly mysterious, are reduced to an orderly scheme. (2) The physical basis of inheritance takes the shape of discrete particles, the so-called genes, carried by the chromosomes. The genes maintain their identity except when they mutate. Every gene introduced into the germinal constitution of a child by one parent, though it may be masked in its expression by a gene introduced by the other parent, subsequently separates out uncontaminated, or pure, as it is called. (3) Given a knowledge of the germinal constitutions of the parents, those of the children can be foretold. It is not usually possible to foretell what germinal constitution any one child will have, the first or fourth child, for example. The kind of prophecy that can be made is as follows. If mental deficiency is produced by a single recessive character and if each parent has one gene for the normal condition and one for the abnormal condition (and thus exhibits

a normal mental condition), it can be foretold that out of every four children on the average one will be abnormal and three normal, though of these latter three, two will carry a masked gene for mental deficiency. (4) Selection is at present our only method whereby improvement can be brought about. The effect of selection is seen to consist wholly in the sifting out of genes. (5) Since selection operates in this manner, a limit is set to the effect which it can produce by the nature of the genes in existence. (6) Mutations enlarge the material upon which selection acts. (7) Little is known as to the conditions which induce mutation. Enough is known to indicate that certain circumstances which induce parental modifications do not induce analogous changes in the germ cells, and therefore do not produce offspring with an innate tendency to exhibit the characteristics which have been forced upon the bodies of the parents.

From the study of the mechanism of inheritance we carry away a picture of self-perpetuating and singularly stable bodies which maintain their properties. Every organism starts life with a packet of these genes in pairs, one member of each being contributed by the father and one by the mother, which constitute the physical basis of inheritance. Since we are here interested in human inheritance we have now to inquire what is known regarding the genes present in man.

CHAPTER III

INHERITANCE IN MAN

THERE are good grounds for believing that the mechanism of inheritance described in the preceding chapter is present in the human and all other species. If this is so, then we have a most important guide to the method to be pursued when it is sought to formulate plans for improving racial qualities, and to the interpretation to be placed upon the effect of selective agencies both in past times and at the present day. We now pass on to ask what is known about the inherited factors which are carried by the human species.

It is one thing to discover the general plan of the mechanism of inheritance and another to investigate the genes present in a species. When it is possible to control matings in a rapidly breeding species, information as to the genes present may be gradually accumulated. A species of fruit fly has been intensively investigated in recent years and much information gathered regarding the genes which it carries. It has even been possible to construct a " map " of the chromosomes showing

the location of many of the genes present in each chromosome. This information, however, has only been gathered as the result of the prolonged labours of many experts working with a species in which all the conditions are unusually favourable. In man the conditions are very unfavourable. Man is a slow-breeding species and matings cannot be controlled. We have to depend upon information contained in well-authenticated pedigrees. Of these there are not many and the information is seldom full or exact.

It is therefore not surprising that our information regarding the genes borne by man is at present very scanty. We have some knowledge regarding certain genes, but we are very far away indeed from being able to construct a "map" showing the location of genes in the chromosomes similar to that which has been drawn up for the fruit fly mentioned above. Under the conditions which exist and must continue to exist, advance in our knowledge must come very slowly. Let us take a few examples of information already accumulated.

Drinkwater has constructed a pedigree covering fourteen generations which exhibits the inheritance of a peculiar characteristic. This characteristic consists in the fact that there is no joint between the first and second joints of the fourth and fifth fingers, and that all the toes, except the big toe, are similarly

affected. An analysis of the pedigree shows that the characteristic is inherited as a simple dominant. That is to say, it is controlled by a single pair of genes. These genes are of two kinds: there are genes for the abnormal condition and genes for the normal condition. Any one individual can have a single pair of genes only. They may both be productive of the abnormal or both productive of the normal condition, or one may be of one kind and the other of the opposite kind. When both genes are of the same kind, then the individual is normal or abnormal in respect of this characteristic as the case may be. When, however, one gene is abnormal and the other normal, the individual exhibits the abnormal characteristic because the abnormal gene is "dominant." In a simple case such as this, when the genetic constitution of the parents is known, it is possible to prophesy what characters will on the average be shown by the offspring of different matings. Thus if two people showing the abnormal characteristic marry, each of whom carries one gene for the abnormal and one for the normal condition, then out of every four children three will be abnormal and one normal on the average.

A number of cases are now known in which inheritance is of this simple type, where, that is to say, a characteristic is controlled by a single pair of genes. As in the above case,

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the gene producing the abnormal character may be dominant over the gene producing the normal character, or it may be recessive to the normal gene. Other cases in which the abnormal gene is dominant are brachydactyly (a condition in which the fingers are short and possess only two phalanges each), cataract, ichthyosis (a rough and scaly condition of the skin), keratosis (warts and callosities on the palms and the soles) and diabetes insipidus. Other abnormalities behave as simple recessives and are inherited in the same fashion as the normal condition is inherited in the cases given above where the normal condition is recessive.

There is one very interesting case in which an important abnormality appears to be inherited as a simple recessive. The inheritance of feeble-mindedness has not been fully worked out; the results obtained by different observers are not altogether concordant. It may be that more than one character is being included under the same term, or it may be that disturbing factors come in. However that may be, it is interesting to note that the inheritance of feeble-mindedness is very similar to that of a simple recessive character. Goddard obtained data regarding 144 children who were the products of 42 marriages between feeble-minded men and outwardly normal women who may, however, have been carrying one gene for feeble-mindedness. (If

we suppose feeble-mindedness to be recessive, then those carrying one gene for the normal condition and one gene for the feeble-minded condition will show outwardly the normal condition.) On the assumption that the wives of these marriages were genetically constituted as above suggested, we should expect that half the children resulting from these marriages would be normal and half feeble-minded. In fact of the 144 children 71 were feeble-minded and 73 normal. The same observer gives data concerning 185 children the products of 26 marriages between parents who though mentally normal may have each been carrying a gene for feeble-mindedness. 122 of these children were examined, and of them 83 were normal and 39 feeble-minded. On the hypothesis as to the genetic constitution of the parents mentioned above the theoretical expectation would be 91·5 normal and 30·5 feeble-minded children. The divergence from expectation is not great in these cases, and these data are therefore concordant with the view that feeble-mindedness is caused by the presence of a pair of recessive genes. Caution is necessary, however, since other data are not so easily explicable on the same hypothesis and the true explanation may be more complicated.

Data regarding the inheritance of eye colour have also been interpreted as showing that a single pair of genes only is involved. It is

improbable that the matter is as simple as this. Almost certainly modifying factors enter in, but it may be that a single pair of genes form the chief determinant. Thus Winge recently collected data in Denmark covering about 1400 children, which may be tabulated as follows:

INHERITANCE OF EYE COLOUR

Marriages.	Number of Children.			Total.
	Blue.	Brown.	Greyish-green or Bluish-green.	
Blue × Blue . .	625	12	7	644
Blue × Brown and conversely . .	317	322	9	648
Brown × Brown .	25	82	—	107
Total . . .	967	416	16	1399

These data are roughly concordant with the hypothesis that brown is dominant to blue, and that all those persons with brown eyes recorded in the table carry one gene for blue, though special hypotheses are required to explain the appearance of greyish-green eyes and other facts brought out in the table.

Up to the present only a few human characters have been found to be controlled by a single pair of genes. In other words, only a few human genes have been identified. When breeding experiments are not possible,

as is the case in the human species, it is very difficult to identify genes which control not the whole but only a part of a single measurable character. Arguing from what is known to be the case in other species, it can be shown to be probable that human characters, such as height and ability, are controlled each by many pairs of genes. But it would be unsatisfactory if further evidence could not be obtained throwing light upon this important point. Fortunately there is such evidence the nature of which may now be shortly described.

If we can measure a character, say stature, it is possible to record the stature of parents and their offspring. In the following table are summarised the results of measuring the stature of fathers and their daughters. Each case, representing the stature of any father and that of his daughter, goes to swell the number in some particular square, defined by the column which corresponds to the father's height and the row which corresponds to the daughter's height. Thus there were twenty cases of fathers 66 inches in height having daughters 60 inches in height. Inspection of the table shows that tallness in fathers is associated with tallness in daughters, and that small stature in fathers is similarly associated with small stature in daughters. This is so because we find no short fathers with tall daughters and no tall fathers with short daughters. The table is empty in these

corners. Such a table is called a Correlation table. It is possible to calculate the extent to which these two measurements are associated, or correlated, by means of a quantity known as the correlation coefficient.

Height of Father (inches).

Height of Daughter (inches).	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	Total
53					1													1
54																		
55							1											1
56					1		1		1									3
57	1		1	5	1	2	1	2	1									13
58		1		2	1	1	2	5	3									15
59	2	2		6	4	5	7	11	3	4	2	1	1					48
60	2		2	8	6	13	18	20	12	8	5	3	1	1				99
61		2	2	9	12	13	24	23	20	17	10	4	3	2				141
62	1	2	2	5	11	22	26	34	28	24	15	14	5		1			190
63			2	5	9	11	27	37	37	32	26	16	8	3				213
64			3	3	3	9	24	18	28	32	35	24	12	6	1	1	1	200
65				1		11	12	9	20	31	26	22	15	4	4	2	1	158
66			1		2	3	8	9	16	26	27	21	18	7	4		1	143
67						1	5	7	4	14	13	11	12	5	4	2		78
68								1	3	5	5	6	5	4	2	2	2	35
69					1		1		1	1	3	7	2	2	2	1		21
70										1	1	4	1	2	1			10
71										1			1	1	1	1		5
72										1								1
Total	6	7	13	44	52	91	157	176	176	197	168	133	84	37	20	9	5	1375

The correlation coefficient is a number lying between —1 and 1. When there is no association the calculation works out at approximately zero. If the stature of daughters was quite independent of the stature of their fathers the correlation would work out at 0. If tall fathers tended to have short daughters the correlation would work out at a minus quantity. When the correlation works out at something significantly greater than zero, as-

sociation is indicated, as in this case between tallness in fathers and tallness in their daughters, and the closer the association the higher is the correlation. In this particular case the correlation is about ·51. Professor Karl Pearson and his co-workers have made a very large number of similar measurements. They took eight physical characters, health, eye colour, hair colour, curliness of hair, cephalic index, head length, auricular height and athletic power, and eight mental characters, vivacity, assertiveness, introspection, popularity, conscientiousness, temper, ability and handwriting. It is obvious that while it is easy to measure accurately head length and some other of the above characters, it is very difficult to make any measurement of other characters such as vivacity and temper. It is, in fact, necessary to remember that the grading of people into groups showing more or less vivacity can have no exact value. Nevertheless people can be graded in a fashion in respect to these qualities, and when this is done it is found that the correlation between children of the same parents ("siblings" in technical language) works out at ·51 for physical and ·52 for mental characters. Similar calculations show that the correlation between parents and offspring for both mental and physical characters works out on the average at a slightly lower figure. The parental correlation is, in other

words, slightly lower than the fraternal correlation as they are respectively called.

Correlation measured in this manner expresses the degree of association between two groups of persons in respect of a certain character. It enables us to measure the amount of association. It does not tell us to what cause or causes the association is due. So far as we have at present gone, it might be that tallness in parents was associated with tallness in children to the degree found because both parents and offspring had been subjected during their upbringing to similar tall-stature-producing surroundings. But it can be shown that the hereditary factor is the only factor which can account for these resemblances. Children always have one connection with their parents, namely, that they are derived from the parental germ cells; children of the same parents always have this in common with one another, that they are derived from the union of two germ cells given off by the same couple. There are no other factors which are always present and which could therefore be held to account for these resemblances. By a process of elimination we arrive at the conclusion that the correlation coefficient is a measure of the strength of inheritance. These results provide strong evidence that the assumption made above is correct. It was assumed that characters such as height and ability are controlled by

many pairs of genes. It can be shown that, when a character is so controlled, we should on theoretical grounds expect to find a correlation of about ·5 between parents and offspring in respect of that character. And we do, in fact, find just about that degree of correlation between parents and offspring in respect of many characters that have been measured. There need be no hesitation in adopting the view that, when the inheritance of a character shows that it is not controlled by a single pair of genes, it is controlled by two or more pairs of genes. It may be noticed that these statistical or biometrical results are also in other respects in harmony with the view that human inheritance is controlled by a mechanism such as was described in the last chapter. The correlations of fathers with their children are, for instance, of the same order as those of mothers with their children, and this is precisely what we should expect if each parent gives to each child of either sex one of each pair of genes with which the child starts life. A further example of the harmony between these two series of results is to be found in the fact that the correlation between parents and offspring in respect of a character works out at less than the correlation between children of the same parents in respect of that character. This is a rather strange and unexpected result. We might anticipate that there would be stronger

resemblance between parents and their children than between the children themselves. But it can be shown that this is precisely the result we ought to expect if the characters in question are controlled by many pairs of genes. The demonstration depends upon the fact that, when the members of a pair of genes are unlike, one usually dominates over the other. Now the result of dominance is to reduce the correlation and, since dominance has more effect upon the parental than upon the fraternal correlation, we should expect to find, as we do, in fact, find, the parental correlation to be lower than the fraternal correlation.

The available evidence is therefore concordant. It all points to the control of characters by genes even when we cannot identify them. The identification of genes is of practical and not merely of theoretical importance. It enables us to put our hands upon them. It enables us to foretell within certain limits what characters the offspring will exhibit. If a character is controlled by a single pair of genes, then, supposing the gene for that character to be recessive, we can foretell that, if two persons each carrying two recessive genes marry, all their children will exhibit that character. Feeble-mindedness, as we have seen, may be inherited in this manner. Again, if two people marry, one of whom carries two recessive genes and the other one dominant and one recessive gene, then on the average

half the children will show the character and half will not. When, on the other hand, many pairs of genes are involved, we can only prophesy within wider limits. We can only say that on the average a degree of resemblance of ·5 will be found in respect of that character between parents and offspring.

The importance of the biometric method does not consist wholly in the confirmation which it gives to the assumption formed on other grounds, that characters such as height and ability are controlled by many pairs of genes, and in the fact that it enables us to foretell the characteristics of offspring within certain limits. It may also be used to discover what characters are inherited. But it must always be remembered that the discovery of an association between parents and offspring in respect of a character does not prove that the cause of the resemblance is to be sought in heredity. No doubt an association between parents and offspring in respect of the use of bad language might be discovered, but the cause would clearly have to be sought in the bringing up of the children in a home where foul language was frequently used. It is only when by a process of elimination no other cause appears to explain the facts that heredity is to be accepted as the source of the correlation. With this in mind let us briefly review what is known as to the inheritance of characteristics of various kinds.

It has already been mentioned that parental correlations are found in respect both of mental and physical characters. It would appear that, not only are the purely intellectual characters such as ability, but also the temperamental characters such as vivacity, and the instinctive characters such as pugnacity, inherited with the same degree of intensity. The question may next be asked whether mental characters are inherited separately or whether they are correlated one with another. Are intellectual characters correlated, for instance, one with another? Is it likely that a man possessing some form of special ability, say the mathematical, will exhibit a more than average degree of general intelligence? Are intellectual characters correlated with emotional characters?

Recent investigations have thrown light upon these problems. It has been found that there is a low degree of association between intellectual qualities on the one hand and emotional qualities on the other. It follows, and it is, as will appear later, a fact of no little importance, that a selective process which sorts out men of a certain type of ability, say of unusual general intelligence, does not at the same time result in separation of a group of men who are markedly different from the rest of the population in respect of their emotional characters. Similarly, a group of men selected for their emotional characters

will not differ in any marked fashion from the rest of the population in respect of their intelligence.

Similar investigations into the relation of the intellectual characteristics one to another suggest that there is a single central capacity pervading all that we think or do, to which the name "general intelligence" is given, and a number of specific abilities, among which may be mentioned the mathematical, the verbal, the literary, the linguistic and the musical. There appears to be a high degree of correlation between general intelligence and the specific abilities. In other words, a person possessing some specific ability, say the mathematical or the musical, is very likely to be also a person of a high degree of general intelligence. It follows that any process which selects men of high general intelligence also selects men possessing specific abilities.

The emotional characters present a far more difficult problem for investigation than do the intellectual. It would seem that there may be distinguished a central factor, which Mr. Burt calls "general emotionality," analogous to general intelligence, but correlated with it only to a small degree. Those who manifest this factor to an exceptional extent are neurotic. There would seem to be two groups of specific emotional characters, the "active" group, including anger,

assertiveness, curiosity and joy, and the "passive" group, including fear, submissiveness, disgust and sorrow. The characters in each group seem to be correlated positively with one another while the two groups as a whole are negatively correlated. Thus men tend to be either "active" or "passive" in their specific emotions. The relevance of these findings to selection is obvious; a selective process which favours a certain specific type, say the submissive, will have wider results than at first appears. The "active" types will tend to disappear and those who survive will exhibit the specific tendencies correlated with submissiveness.

Some reference has already been made to the inheritance of feeble-mindedness. It must not be assumed that all persons classed as feeble-minded inherit that condition. The matter is discussed later and it will be shown that in perhaps 70 per cent. to 80 per cent. of the cases of feeble-mindedness, that condition can be detected in the ancestry. Other abnormal and subnormal mental conditions are also inherited, but it is not clear how far the inheritance of these conditions is specific. The fact that the mentally deficient are more prone than the rest of the population to develop insanity or epilepsy seems to show that there is no clear-cut distinction between these conditions. It is on the whole probable that it is general nervous weakness and in-

stability which is inherited and that this condition may manifest itself according to circumstances in either one way or other of several ways.

Are mental characters correlated with physical characters? If we were to aim at producing a race with fine physique, should we be likely to change the mental characters for the better or for the worse? The point is of no little importance in view of the fear often expressed that the elimination of the physically defective may involve the loss of persons with remarkable mental endowments and even of genius. That gross mental abnormalities are at times associated with physical malformations such as a cleft palate is well known. Otherwise there is little or no evidence of association between specific bodily characteristics and mental endowments. There is, for example, no scientific foundation for "phrenology." There is some evidence, however, the general trend of which is to show that a sound mind does tend to go with a sound body. It has been found, for instance, that among boys in a school those who exhibit most ability are generally somewhat better physically developed than the rest of the school. There is in any case no support for the view which is sometimes expressed that those who are more intelligent than the average are less well developed physically than the average.

The inheritance of physical characters may be treated even more briefly. There is abundant evidence to show that not only are the larger and more obvious characters such as height inherited, but that many minute physical peculiarities are inherited with equal intensity. There is evidence that physical characters are correlated one with another and that in consequence the selection of one characteristic may often involve the selection of other characteristics. One interesting problem in this connection is the possible association between physical characters and liability to disease. It has been thought that those liable to contract tuberculosis could be distinguished by the possession of peculiar physical characters, and that persons of fair complexion are more liable to certain diseases than others. It does not, however, seem to have been established that such physical differences as are found between persons in this country are associated with liability either to disease in general or to specific diseases in particular.

The inheritance of disease demands some further attention. If the term is used in a wide sense, it may be held to include structural malformations. Structural malformations may be large and obvious, such as polydactylism, that is to say, the presence of additional digits, or they may be small, such as defects in the filtering apparatus of the kidney which

cause kidney disease. Such structural malformations are known to be inherited with the usual degree of intensity. In the narrower sense disease means some abnormal condition following upon the invasion of a parasite. In one sense of the word parasitic diseases are not inherited. Only very exceptionally, as in the case of syphilis, is the parasite ever passed on from parent to child. But liability to contract parasitic diseases is variable. There is evidence to show that the larger groups of the human race differ in their susceptibility to disease. Negroes appear to be less resistant than Europeans to tuberculosis and pneumonia, while the Chinese are more resistant than Europeans to typhoid fever. It is probable that similar differences in susceptibility to disease exist between members of the same race. Evidence is difficult to obtain because it is very difficult to ascertain whether all those contracting the disease have been equally exposed to infection. It is certain that there are inborn differences between persons in this country in respect to resistance to disease, but it is uncertain how far resistance is specific to certain diseases or certain classes of diseases. There is probably a condition of general susceptibility complicated by the existence, at least to some extent, of specific susceptibilities. It may be observed that in the last analysis these susceptibilities must be structural in nature, depending upon peculiarities which

render the entry of the parasite easy or which favour its multiplication once it has entered.

Reference may perhaps be made in this connection to cancer, which appears not to be in any case wholly due to parasitic invasion. It has been shown that certain strains of mice are more prone to develop cancer than others. It has not been certainly shown that the same holds good in the human race. Figures have been given which indicate that among the relatives of sufferers from this disease there are more cases of the same disease than would be expected if the incidence was the same as in the population as a whole. This would indicate that there is an inherited disposition to develop the disease, but it cannot at present be said that there is any proof that this is the case.

This brief review of our knowledge as to what characters are inherited by man and as to the associations obtaining between these characters requires to be supplemented by some reference to the problem of mutation in the human species. What has been said of mutations in general holds good of mutations in man. Mutations are rare and we are ignorant of their causes. This leads us to consider the influence of what have been vaguely called "racial poisons." This term is used, often in a most unscientific manner, to cover certain substances or conditions

which are supposed to have deleterious effects upon racial qualities. The term is employed by certain writers in such a manner as to indicate that they have something in mind other than a selective process leading to unfavorable results. If any such results are produced, it must be by means of inducing unfavorable mutations.

Alcohol has been regarded as a "racial poison." Several series of experiments have been made during the course of which animals have been first heavily dosed with alcohol and have afterwards been allowed to bear offspring. The latter may show traces of the treatment to which the parents were subjected. An analysis of the effects leads to the conclusion that, while some of the weaker zygotes are killed off, others show mutations. It is necessary to remember that the parents have been very heavily dosed with alcohol, and the conclusion to be drawn is that a very heavy dosage can disrupt the genes and cause mutations much in the same manner as X-rays and radium can bring about mutations. But there are no grounds for concluding that the alcohol consumed by even the most habitual human drunkard has any such effect, because the doses given experimentally to animals are so very much larger than the amount ever taken by man. Observations upon the children of drunkards show no signs of any changes in their germ plasm attributable to

the alcoholism of the parents. There is no evidence that alcohol does cause mutations in man and there is similarly no evidence that other substances to which the term "racial poison" has been applied do so.

Another belief, formerly very prevalent, is found upon analysis to imply that mutations can be brought about under certain circumstances. It was formerly thought that, if a mother experienced a powerful emotional shock about the time of conception, the offspring would show traces of these "maternal impressions," as they were called. It is now agreed that there is no evidence whatever to this effect. Another matter calling for mention here is the belief that children of older parents differ from those of younger parents. This belief has some foundation in fact. It appears that the older a mother is, the less suitable is she in some respects to nourish her offspring while within the womb. But any effect so produced upon the children of older parents is wholly caused by the environment. There is no reason whatever to think that parents of advanced years tend, because they are old, to endow their children with an inherited equipment different from that with which they endowed their earlier-born children.

The last point which it may be desirable to consider in this chapter is the importance to be attached to inbreeding and outbreeding

respectively. There has been much misapprehension in connection with this problem. These different forms of matings have been sometimes extolled as advantageous and sometimes decried as harmful. A correct appreciation of the matter must be founded upon a grasp of the mechanism of heredity. Neither inbreeding nor outbreeding is in itself advantageous or harmful. The results of any mating depend upon the elements which enter into the cross from either side. Inbreeding may sometimes be very advantageous and sometimes very harmful, depending upon the nature of the genes which are contributed from either side. And the same applies to outbreeding. In general it may be said that among a group of animals the members of which are pure for desirable characters, inbreeding is advantageous. Under these circumstances inbreeding prevents the possible entry into the strain of undesirable genes. By inbreeding a sound and pure strain can be kept in that condition. At the present day, however, racial groups in civilised countries are anything but pure; there are present in the population a very large number of alternative genes. Many of the less desirable genes are recessive, and undesirable characters are thus apt to be brought to light by inbreeding within a strain which carries these undesirable genes. Thus feeble-mindedness appears to be a recessive character, and inbreeding within a

strain in which the gene for feeble-mindedness is present may result in bringing this latent character to the surface. As we have seen above, if two normal people marry, each of whom carries one normal gene and one gene for feeble-mindedness, one quarter of their offspring will on the average be feeble-minded. It is such results of inbreeding as this which cause this form of mating to be regarded with disfavour. Observations show that inbreeding is more common and that feeble-mindedness is more widespread in German country villages than in towns. The latter is probably a result of the inbreeding.

It thus appears that on account of the genetic constitution of modern civilised races the immediate results of inbreeding may be bad. If the method sometimes followed by animal breeders was adopted, inbreeding could be used with the object of bringing undesirable latent genes to light and then of eliminating them. Such drastic policies are, however, applicable only to domestic animals and not to men, and therefore inbreeding is best avoided. Similar considerations must guide us in forming a judgment as to the desirability of outbreeding. Whether the results are good or bad will depend upon the nature of the genes which go into the cross. It is difficult to be more precise, but in general it may be said that we should hardly expect crosses between such widely separated racial

groups as Europeans and Chinese to be successful. The genes now carried by each group are the foundations of at least moderately successful and distinct racial types, and it is hardly likely that a mixture of genes would produce an equally coherent and satisfactory type. Nevertheless it is always possible that such crosses might produce a happy blend of characters, though a successful outcome is more likely as the result of a less wide cross than that supposed above. Indeed there is reason to think that some of the most gifted racial types which history records have been the product of lucky mixtures. But these fortunate outcomes are of the nature of accidents and should not mislead us into advocating outbreeding as a method of racial improvement.

CHAPTER IV

ENVIRONMENT AND INHERITANCE

If an animal is to take shape and grow to the adult form, appropriate surroundings are as essential as a fertilised egg. The fertilised egg will only survive within certain limits of temperature and moisture, and the growing organism will sooner or later require food of a certain kind. In other words, a suitable environment is as essential as an inherited basis. Using the word environment in this broad sense it is impossible to say that either one or other factor is the more important in the development of the organism to the adult stage. Using the word in another sense, it is not only possible but very important to discuss the relative parts played by inheritance and environment respectively. We can ask what part is played by these two factors respectively in producing the differences which we observe between members of the same species. If we divide men into the tall and the short, we can ask whether it is chiefly to differences in the hereditary endowment or to differences

in the surroundings with which they have come into contact that these differences in stature are to be attributed. If the evidence is to the effect that one factor is in this restricted sense distinctly more important than the other, it has to be remembered that this conclusion is not in any way incompatible with the statement made above, that in a broader sense both factors must be held to be equally important. Our problem in this chapter is the relative importance of heredity and environment in the production of the differences between men. Until light has been thrown upon this problem we shall not be in a position to form an opinion as to the part played by heredity in making men what they are, and that is the first question to which we require an answer within the field of the science of eugenics.

It is a matter of common knowledge that if we take two cuttings from the same plant and place one in a well-watered and well-manured pot and the other in less favourable surroundings, the former will thrive and grow into a large, vigorous plant, whereas the latter will form a poor, stunted specimen. Since both originated as cuttings from the same plant, there can be no differences in their hereditary endowments, and the striking differences which are observed must be due to the different environments with which they have come into contact. Similarly

members of a species of tree growing in a poor soil near the coast are usually stunted and misshapen, their shape having obviously been distorted by the prevailing wind, whereas representatives of the same species growing in a favoured inland situation are usually shapely, well-developed specimens. In this case there may well be inherited differences between the former and the latter, but it is clearly likely that these observed differences are due rather to the environment than to inheritance. Again, there may be seen between sessile animals such as oysters similar differences, which are clearly connected with the differences in the surroundings, and especially in the food supply with which they have been brought into contact.

These and similar observations show that sessile organisms, which include most plants and some animals, are influenced to a very considerable extent by differences in the environment in respect of certain characteristics such as size and shape. But an oak remains an oak and a geranium remains a geranium, easily recognisable as such on examination, however different the specimens may appear at first sight. The specific characters by which the specimens are recognised are not changed, but different surroundings have profoundly important effects upon the development of certain organs.

Free-living organisms, on the other hand,

are far less susceptible to environmental influences. Owing to the very fact that they are free-living, it is essential to them that they should reach and maintain the size and shape that is characteristic of the species, whereas, on the other hand, it is advantageous for sessile organisms to bend, so to speak, in respect of certain characters to environmental influences. An oak growing in an exposed situation cannot escape from the prevalent winds, and it is advantageous that it should be able to allow its form to be moulded to suit its surroundings. Whether a rabbit lives on the sea-coast or inland, it can obtain shelter, and in order that it should lead that kind of life which alone can give it opportunity to maintain itself and bear offspring, it is necessary that it should grow to the size typical of the species. And in fact we find that wild rabbits do approximate to a uniform size and shape to a much greater extent than do trees of any one species.

Thus free-living organisms have a much greater power of resisting such variations in the environment they come into contact with than have sessile organisms. This power of resistance is, of course, not absolute. The genes which a rabbit bears when it comes into the world do not cause it to reach a certain size and weight at a certain age irrespective of the circumstances with which it comes into contact. If two rabbits with similar genes

are exposed, one to favourable surroundings, including good food and shelter, the other to poor surroundings, the former will become heavier and longer than the other. But the differences which could be thus artificially produced are not very great, and efforts to make them greater would soon result in the death of the starved rabbit, showing that free-living organisms tend to resist these influences, so to speak, to the death, rather than be moulded as sessile organisms are moulded. Differences, however, which can be experimentally produced are not here in question. We are interested in the differences that are produced by such variations in the environment as actually occur. And the variations normally encountered are such that they exert no very great moulding power.

Before we come to consider the extent of the differences which are thus produced, it may be noticed that certain important consequences follow from the fact that some differences between members of the same species are due to environmental causes. If one wild rabbit is found to be longer than another of the same age, the explanation may either be that both rabbits have approximately the same inherited endowment and that one has encountered more favourable surroundings than the other, or that the surroundings have been the same for both, and that one rabbit has an inherited disposition towards

greater length than the other. When two animals differ in respect of length or of any other character, mere inspection cannot tell us what the reason is. It is necessary to have information regarding the ancestry of the animals and the conditions to which they have been subjected during their development. Now selection seizes upon differences without regard to their causes. The individuals selected may be selected either on account of their development by reason of a favourable environment, or on account of their development by reason of their better native endowment. It follows that selection of the former kind is unable to bring about racial change. Racial change follows only upon the selection of individuals differing from others by reason of the possession of a different innate endowment. Natural selection acts blindly and seizes upon characters irrespective of their causes. Natural selection will in the long run effect racial change, because among the individuals selected there will always be some who are selected on account of their innate endowment. If, therefore, artificial selection is to be less blind and more efficient than natural selection, it must aim at selecting individuals on account of their inborn and not of their acquired characteristics. This it can only do when the genetic constitution of the individuals to be selected is known. It will be seen that these considerations are

of importance when we come to deal with practical problems of racial improvement.

Returning now to the main argument of this chapter, we are in a position, on the basis of what has gone before, to take up the problem of the part played by the environment in man. In general the situation of man is similar to that of other free-living animals. He shares with them the tendency to resist the moulding force of the environment which shapes so profoundly the structure of sessile organisms. But his position is peculiar and in certain respects different from that of other closely allied animals. In the first place, civilised men have very profoundly modified their surroundings. That this is so is apparent if we think for a moment of the kind of life led by the inhabitants of these islands before the Roman conquest. It must have been very similar to that led by barbarous races in various parts of the world at the present day. There were no striking differences between one section of society and another as regards food, shelter and general mode of living. Contrast this with modern conditions. Side by side in the same city dwell rich and poor, the former able to supply themselves with every kind of refinement in the way of food, shelter and clothing, while the latter are not infrequently unable to provide the bare means of existence for themselves. One man may work in a coal

mine in artificial light, another at sea exposed to every kind of weather, another in a stuffy office with little or no opportunity of exercising his muscles, while a fourth may work in a cotton mill in a damp warm atmosphere.

Our problem is to discover not what differences might be produced by extreme variations in the environment, but what differences are actually produced by the variations which normally occur. The first tentative conclusion to which we are led is that whereas man, like other highly organised animals, is so constituted that he tends to resist the moulding force of the environment, he is exposed to surroundings so artificially diversified that we may expect to find the environment to be of somewhat greater importance in producing modifications in his case than in that of animals closely allied to him. Before, however, we attempt to estimate the importance of the environment in producing modifications, it is desirable to note, if only to put aside for later consideration, the fact that man is unlike other closely allied species in one other very important respect.

When we consider the differences between men, we commonly have in view the whole make-up of the men in mind. We think not only of their respective statures, eye colours and weights, but also of their abilities, temperaments and characters. One man may possess good manners and refined tastes and

be well informed, in which respects another may be strongly contrasted to him. A little reflection shows that into the production of some of these differences, the mental differences as we may call them, there enters in the case of men a third factor. Not only do they differ in the inborn strength of their intelligences and in respect to the surroundings among which they have been brought up, as do animals, but they also differ in respect of what their minds have acquired. Two men might be endowed with very similar brains and be brought up under very similar physical conditions, but if one was well educated and the other neglected, there would be profound differences in their final make-up. Animals are so constituted mentally that they are unable to make any considerable mental acquirements, and we can therefore neglect such differences as may appear between them on this account. Among men this is very emphatically not so. Men not only acquire very different degrees and kinds of knowledge, but also very different customs and habits.

Very important and striking differences between men thus arise owing to differences in their mental acquirements. These acquirements are made from the social environment, which must be sharply distinguished from the physical environment. The former consists of the store of knowledge, habits and customs accumulated by society. The latter consists

of all those factors taken together of the nature of food, light, temperature and exercise. The social environment plays so small a part among animals that for practical purposes we may consider all differences that are observed as due to differences either in the hereditary equipment or in the physical environment. Differences between men in respect of their bodily characters are likewise due either to inheritance or to the physical environment. Similarly, differences in the bodily substratum of the mental characters, namely, the nervous system, are also due only to the same two factors. But in the final make-up of human mental characters, acquirements from the social environment play a very important part.

Let us now take up again the attempt to estimate the relative importance of inheritance and of environment. Let us take bodily characters first, in which case we have only inheritance and the physical environment to consider. This problem has been attacked by using the method of correlation described in the last chapter. It has been sought to measure and express the degree of association between certain characters and certain environmental conditions just as the degree of association between parents and offspring or between children of the same parents in respect of certain characters was measured. It will be remembered that if there is no

association the result works out at approximately zero, and that if there is complete association it works out at approximately 1. The method does not tell us to what the association, if any, is due; that is a matter which has to be investigated later.

Using this method, an elaborate study has been made by Miss Barrington and Professor Karl Pearson regarding the relation between vision and certain environmental conditions. They employed data collected in Edinburgh and measured the association between different grades of vision and different aspects of the environment. A large amount of information was available regarding the home conditions of these Edinburgh persons whose eyesight had been measured. Out of this information the four following home characteristics were chosen for investigation as to their possible influence upon eyesight. (1) Number of people per room of the house. (2) Economic condition of the home, which was estimated from information available as to wages and as to appearance of the homes as judged by employers, police, charity officials and others. (3) Physical condition of the parents, which was classed as good or bad. (4) Moral condition of the parents, which was estimated from information giving details as to illegitimate children, frequent appearance in the police court and similar facts. Home conditions thus classified serve as indicators of

the physical environment. Where economic conditions are good the physical environment will not be the same as where they are bad. Food will on the average be better and more regular, for instance. Where the moral condition of the parents is good, the home will on the average be cleaner and brighter. It is not easy to make such classifications precise, but there is no doubt that with care they can be made to correspond to facts. It is not difficult to cast ridicule upon attempts to classify parents according to their moral condition and to make other similar distinctions, but there can be no doubt that such distinctions carefully made do imply different home surroundings. That is all which concerns us here.

The mean of all the correlations between the eyesight of the children and home conditions worked out at — ·04. Thus in this inquiry no association was found between vision and the physical conditions under review taken together. The same was found to be equally the case when each classification of home environment was considered separately in its relation to vision. Other similar inquiries have been made. To quote only one. Rhodes found a negligible degree of association between the state of caries in the teeth of children aged twelve to fourteen years and the home environment. It may be said that in general the result of all such

inquiries has been to disclose small or negligible degrees of association between the characters measured and the aspects of the environment which have been considered. What conclusions should be drawn from these results?

It must be remembered in the first place that there are included in the environment a very large number of factors, and that the association of but few of them with any characters has been measured. Vision may, for example, be affected by aspects of the surroundings that were not taken into account in the investigation mentioned. Nevertheless the cumulative effect of these inquiries all leading to approximately the same result is impressive. If environmental factors do frequently mould the expression of characters, it is remarkable that these inquiries should not yet have lighted upon a single well-authenticated case. While such considerations are of no little weight, they cannot of themselves lead to any definite conclusion.

The problem may be approached from another angle. In the last chapter it was stated that the correlation between parents and children in respect of many characters works out at about ·5, and that as between children of the same parents it works out at a slightly higher figure. Incidentally it may be observed that vision is one of the characters which have been measured and which gives

these results. For the reasons mentioned these correlations can be accepted as measurements of the strength of inheritance. Let us start from this basis and attack our problem.

The correlation between children of the same parents is on the average about ·54. But children of the same parents are persons whose whole ancestry is identical. It would therefore seem to follow that 54 per cent. of the variability of the whole population is due to differences in ancestry, 46 per cent. to differences among persons of the same ancestry. To what then are these differences among persons of the same ancestry due? They cannot be due to mutations. Little as we know about mutations, we do know that they are relatively so rare that they cannot possibly have any appreciable effect in producing variability. Are they to be ascribed to the environment? This would seem to be the obvious answer. But such an answer is incompatible with the results just described, of measuring the effect of various aspects of the environment upon different characters. These results seldom indicate that more than 5 per cent. of the variability is due to environmental causes.

The work of Mr. R. A. Fisher has solved this difficulty. In order to understand his explanation it is necessary to recall what was said in an earlier chapter about the mechanism of inheritance. We have to think of the

physical basis of heredity as consisting of pairs of genes, one member of each pair being derived from each parent. When the two genes of a pair are unlike in a parent, some children will receive one type of gene, while the others will receive genes of the other type. In consequence, children of identical ancestry will differ in their hereditary composition. When many factors are present, both parents will be liable to be impure for several of them, and even children of the same parents will seldom or never be genetically identical. The amount of variation so produced by segregation of the parental genes bears a calculable relation to the amount of variation produced in the population at large by the same factors. When this source of variation is taken into account, it is found that a very small proportion indeed remains to be ascribed to differences of environment. The environment, in other words, is thus only required to account for a small degree of the variability and not for nearly half, as appears at first sight in the case of persons with the same ancestry.

Our problem is to find out what part the environment plays in producing differences between men. Recollecting that we have for the moment left the social environment out of account, the different ways of approaching the problem just described may be said to support the following conclusion. Heredity

is of far more importance than the physical environment in producing the bodily differences in question. It is not easy to be more precise, but it may be said that on the average heredity accounts for at least 90 per cent. and environment for not more than 10 per cent. of these differences.

These conclusions refer to structural characteristics such as stature. The same method of correlation has been applied to such characteristics as health, and a high degree of correlation has been found between relatives in respect of health. But caution is necessary before health, in the sense not only of freedom from disease but also of general physical well-being, is attributed to inheritance in the same measure as stature is attributable to heredity. Physical well-being is no doubt in large measure dependent upon a sound constitution, and the differences between men in respect of their constitutions is due in greater measure to differences in heredity than to such differences in the environment as occur. Physical well-being is, however, also influenced directly by environment conditions. Recent investigations have shown the importance of proper ventilation and of sunlight. Proper ventilation implies that the air should have adequate cooling power. "An adequate increase of cooling power," says Dr. Leonard Hill, "puts up the basal metabolism, that is, the heat production

of the resting body, even 50 per cent. to 100 per cent. We know that thousands of clerks, shop assistants, factory hands, taken from lives spent in monotonous, over-warm places, were changed from feebly developed, nervous, dyspeptic men into strong, healthy soldiers by training in open-air exercises during the Great War."

There is perhaps some picturesque exaggeration in this statement. It is clear, however, that environment does play a considerable part in the production of physical well-being. The position may perhaps be made more clear if we compare the body to a machine. The differences in the machines that different men possess are due much more to inheritance than to environment. But the best machine will run badly without oil, and ventilation and sunlight may be compared to oil. Oil, however, cannot do much to make a machine work unless there are proper oil channels, and these channels are part of the structure. The upshot of the matter is that the environment directly influences the manner in which the body functions, and there are sufficient differences in the environment to make it responsible in an important degree for the manner in which it does function.

These observations and these conclusions apply only to characters other than mental characters. Mental characters as expressed are the product not of two factors only but

of three, namely, the innate endowment, the physical environment and the social environment. We have now to inquire what part is played by these three factors respectively in producing the results that we see.

That which is acquired from the social environment may be regarded as taken up or absorbed by the nervous system, which is the physical substratum of the mental characters. There is reason to think that the nervous system, which of course includes the brain, is built up just as any other bodily organ is built up. It is the product of the reaction of the environment upon the innate endowment. There are, in other words, genes which under the stimulus of food, temperature, light and other aspects of the surroundings bring about the development of a certain type of nervous system. This nervous system is the physical substratum of the intellectual abilities, instinctive and temperamental characteristics. And the differences which men exhibit in respect of their mental characters, apart from such differences which may be due to different amounts and kinds of acquirements that may be absorbed, are due in far greater degree to inherited than to environmental differences. A man's nervous system, like his muscular system, is more a product of his genes than of the surroundings with which he has come into contact. He can by exercise develop his muscles to some

extent, perhaps to a greater extent than he can develop most of his organs. But the differences in muscular power are chiefly due to inherited differences, and so too, perhaps to a greater degree, are differences in the nervous system. This is in accordance with what is after all common knowledge. A man is born an athlete; he does not become one by training, however assiduous. A man born with a good brain whose early education has been curtailed or neglected finds that his brain power at the age, say, of twenty-five or thirty, is no less than it would have been, though he suffers in comparison with his more fortunate contemporaries in that he has made few or no acquirements whether in the way of knowledge or of mental habits. In the building up of the nervous system the physical environment plays a wholly subsidiary part so far as the production of differences between individuals is concerned.

Our problem now is to inquire into the importance of mental acquirements derived from the social environment in producing differences between persons. The problem can be approached in two ways. We may ask what it is that has been acquired by or added on to this substratum. If it is possible to strip off what has been added on, then it is possible to say that in the case of one man so much more has been added on than in the case of another. This provides an indication

of the part played by the social environment in producing differences. Again, we can ask how far differences in the physical substratum facilitate the making of acquirements. If it is the case that there are vast acquirements to be made, and that the differences in the nervous system are of little importance in facilitating acquirements, then the differences between men will be almost wholly due to the differences in the acquirements that they have made. If, on the other hand, differences in the substratum greatly facilitate the making of acquirements, then the greater the mass of possible acquirements, the greater will be the possible effect of differences in the substratum in producing differences in the intellectual make-up of men as seen in everyday life.

Up to a certain point it is easy enough to recognise and strip off acquirements. It is now generally held that our ancestors of the Neolithic age were on the average little, if at all, inferior to us in intellectual capacity. But in a sense the differences between us and them are vast. The average member of a modern civilised community has acquired not only knowledge that was not available before, but methods and habits of acquiring and expressing knowledge. His instinctive desires, his pugnacious and sexual tendencies, are controlled by standards of conduct derived from the social environment. In short, the

total mental make-up of the civilised man differs profoundly from that of the Neolithic man, and it is easy to see that these differences are due to the fact that to the physical substratum of the mental characters of the former there have been added acquirements derived from a rich social environment.

The stripping off of the acquirements in such a case as this in a rough-and-ready manner is not difficult. And in the light of these considerations it is evidently legitimate to hold that in a certain sense the social environment does produce, as the physical environment never produces, profound differences. By far the greater part of all that distinguishes us from our Neolithic ancestors may be set down to the social environment. Applying these considerations to our immediate problem it is easy to see that in the same sense mental acquirements are responsible for differences between persons in modern communities. One man has acquired knowledge and habits that another has had no chance of acquiring. This, however, does not touch the heart of the problem. Having made this subtraction of obvious acquisitions, we have left before us men whose mental characters are very different and to whom we apply, as the case may be, the adjectives brilliant, intelligent, dull, timid, morose, pugnacious, cantankerous, vigorous, lethargic, and so on. The problem is whether these

mental characteristics are wholly the product of heredity and the physical environment, as are height and weight, for example, or whether the social environment in some degree moulds them and thus is responsible to that extent for the differences noticeable.

Some investigations carried out by Mr. Cyril Burt throw light upon this question. He tested the intelligence of the pupils in two schools in the same London borough, using a modified form of the Binet-Simon system for the purpose. The pupils in one school were drawn from families ranking among the best which send their children to an elementary school; the other school was situated in one of the meanest of the overcrowded slums. The table on p. 98 shows the average number of tests passed by the pupils in the two schools, classified according to age. It also gives the average "mental age" of the pupils. A child whose performance in the tests is better than the performance of other children of his age is given a "mental age" superior to his chronological age. Thus if a child of seven is given a "mental age" of eight, it means that the child has passed tests which experience has shown to be passed on the average only by children who have reached the age of eight.

The table shows that at all ages the children from the superior school pass a larger percentage of tests than the children from the

INTELLIGENCE OF CHILDREN IN TWO LONDON SCHOOLS

Chronological Age.	Average Number of Tests passed.		Average Mental Age.	
	Superior School.	Poor School.	Superior School.	Poor School.
7	44·4	31·2	8·99	6·1
8	48·5	36·3	10·1	7·2
9	51·0	42·6	10·6	8·4
10	54·3	46·8	11·5	9·6
11	56·2	50·4	12·1	10·3
12	57·5	52·9	12·8	11·0
13	59·3	55·2	13·7	11·7
14	60·5	54·8	14·2	11·6

poor school. The latter have "mental ages" which are on the average more than a year behind their chronological ages. The superiority of the former is less marked among the older age groups, and this is due to the fact that many of the brightest of them pass into secondary schools at eleven or twelve years of age.

The children from the superior school have been exposed to a more favourable social environment than the children from the poor school. Mr. Burt gives the following table, based on pre-war figures, illustrating the difference in the social environment of three classes of London school children.

HOME CONDITIONS OF CHILDREN ATTENDING SCHOOLS OF BEST, MEDIUM AND POOREST SOCIAL STATUS

	Best.	Medium.	Poorest.
Average weekly income	49/6	37/3	26/4
Average number of children living at home	2·9	4·1	5·2
Average number of rooms in home .	4·7	3·4	2·3
Average weekly rent .	12/8	10/1	5/8

These tests aim at making precise the judgments that would be passed by anyone who tried to estimate the general intelligence of these children. The differences between the children which are obviously due to social acquirements have not been considered. The attempt is to judge their intelligence in the ordinary common-sense meaning of the word. The question now facing us is whether what we have measured is the physical substratum only (*i.e.*, the product of heredity and physical environment), or whether it is the physical substratum with acquirements from the social environment (*i.e.*, the product of heredity, physical environment and social environment). Further consideration of Mr. Burt's work gives a clue to the answer.

There were sixty-six tests in all. The

performances of the children from the superior school were better than those of the children from the poor school for every test except one, the test for "suggestion." In this one test, which takes the form of setting a trap for the examinees, the children from the poor school came out best. Commenting upon this fact, Mr. Burt says that "the slum child unblushingly recognises that the examiner is setting a trap for him. The child of nicer manners hardly entertains such a suspicion and conscientiously searches for minute differences." Analysis of performance in the other tests shows that the following were relatively easy for children from superior schools: (1) tests requiring linguistic facility, (2) scholastic tests, (3) memory tests, (4) tests depending upon items of information imparted in early life in a cultured home. Other tests, on the contrary, were relatively easy for children from the poor school: (1) tests depending upon familiarity with money, (2) tests perceptual rather than conceptual, (3) tests of a practical kind, (4) tests depending upon critical shrewdness. It seems clear that, where the children of the superior school markedly excel, out of school experience has assisted them. "Facility in reading, counting, spelling, in the reckoning of money, in the use of words, these and other aptitudes enumerated are just such qualities as might be deduced from the peculiar environment and

peculiar traditions amid which the two groups respectively live and move."

It is evident that what has been measured by these tests is not the intellectual machine alone, the intellectual capacities which develop as the stimulus of the physical environment plays upon the inherited factors, but these intellectual capacities together with acquirements from the social environment. And the same applies to all tests which have so far been devised. It applies with even greater force to the far rougher judgments which we each make of other persons' mental capacities. This is so, it should be remembered, when we have stripped off the obvious acquirements in the shape of knowledge of specific facts. The fact is that when considering the intellect we cannot altogether subtract acquirements. This is equally, if not more, the case when we consider the instinctive and temperamental characters. When we consider the energy, pugnacity, conscientiousness and other capacities of men, we are considering characters into which acquirements from the social environment enter.

If we cannot strip off the acquirements, then for all we know the differences observed may, so far as we have at present gone, be due to differences in the acquirements. It may first be noticed that, where the social environment is the same, or at least very

similar for a whole group, as large differences in intelligence and other mental qualities are to be observed between them as between persons whose surroundings are not the same. Take orphanages, for example. The social environment is much the same for all. The observed differences between the inmates must be due in the main to inherited differences. Further, it has been found by Professor Pearson that the correlation between children of the same parents brought up in an orphanage is approximately similar to the correlation between children of the same parents who have been sent to different schools by their parents. Not only, therefore, do mental differences appear where the social environment is the same for all, but these differences are of the same degree as where the social environment is diverse. These and other similar considerations make it appear that though we cannot remove acquirements when judging intelligence, the acquirements remaining can be responsible only to a small degree for the differences.

In the second place, where the inherited qualities are the same but the social environments different, there the persons concerned are so much alike as to be almost indistinguishable. Such cases are provided by so-called identical twins. Identical twins are persons always of the same sex who have been derived from the same fertilised egg, which

in an early stage of development has divided into two and from which have developed two perfect individuals. Such twins have therefore the same genes. It is true that such twins are commonly brought up under very similar conditions in their early days, but they often go into different professions, lead very different lives and see little of one another in later years. Nevertheless, if we neglect the obvious acquirements in the shape of knowledge and judge their intellectual, emotional and temperamental characters we find them to remain in after life very closely alike indeed. This again is evidence that the social environment produces no great differences between persons. Identical twins were first studied by Sir Francis Galton and subsequently by Thorndike among others, and those who are interested in the problems under discussion in this chapter are strongly advised to make themselves acquainted with the remarkable results disclosed by these studies.

These considerations do push the matter rather further. They strongly suggest that the social environment is not to any large degree responsible for such mental differences as we observe. But great caution in these matters is necessary. Let us take the case of Mr. Burt's children. It is very necessary that, since there is an element in the mental capacities of the children as

presented to us which is acquired from the social environment, the tests should not be so framed as to put a premium upon the possession of one kind of acquirement rather than of another. It is still more important to remember that the social environment may present every degree of diversity. For children in an orphanage it is very uniform; there is a certain uniformity in the social environment for all the inhabitants of this island, though there are considerable differences as between professions and classes. There are wider differences as between different countries and between the conditions in the same country at one period in its history as compared with another. That it is essential to bear these facts in mind may be seen if we suppose that an effort is being made to measure the degree of assertiveness. Differences in assertiveness between orphans in an orphanage may be attributed to inherited differences. Similar differences between members of different social classes in this country may be in some degree explicable as due to the fact that in one social class, that which sends its sons to public schools, assertiveness is more encouraged than in those social classes which send their sons to elementary schools. In another country under an oppressive régime self-reliance may be determinately discouraged, or it may have been formerly discouraged in a country where

conditions have now changed. Marked differences between one social environment and another can undoubtedly produce mental differences, and if we neglect large differences between one social environment and another we shall be led into the error of attributing differences, which are due in part to the social environment, entirely to heredity.

It is only legitimate to neglect the social environment as a factor productive of mental differences when there is a considerable degree of uniformity in the environment to which the persons under consideration have been subjected. While there is a fair degree of uniformity in this country, there is enough diversity to put us on our guard when dealing with members of different classes. There is so much diversity as between one country and another that some authors have fallen into error by assuming that any observed differences are to be attributed wholly to heredity. Our conclusion, therefore, must be that so far as persons in this country are concerned, the mental differences which we observe, after stripping off the obvious acquirements in the form of knowledge of facts, habits, customs, manners, are due only in very small part to differences in the physical environment, and in a varying, though never to a large, degree to differences in the social environment and for the greater part to inherited differences.

There remains to be mentioned one more point of no little interest in relation to the social environment. If we take social acquirements to include not only those elements which become imbedded in and cannot be detached from the mental characteristics of men as we observe them, but also all those other elements which are obviously acquired and as a rule easily detached, such as knowledge, we may ask how far different degrees of innate intelligence enable different uses to be made of the social environment. The point may be put crudely in this way. Suppose that there are two men, one of whom is distinctly though not greatly more intelligent than the other. Suppose further that they are both given a very thorough education with every opportunity of making acquirements. Will the result be that the differences between them are increased or lessened? In the absence of information their is no reason to expect one result more than another. It might be as though we had started with a foundation one foot high in one case and two feet high in the other, and had then added ten feet to each, with the result that in the end they bore the relation of 11 to 12, whereas originally the relation was as 1 to 2. Or it might turn out that the initially better endowment of the one had enabled him to absorb so much more than the other that the original difference became enlarged by education.

Experience would seem to show that the greater the opportunity for a group of persons to make acquirements, the more do in the end those with an endowment above the average stand out. With this conclusion most of those who had experience in advanced teaching would probably agree. There is no sign that an equal possibility of making acquirements results in obscuring differences which were originally obvious. The evidence, in fact, would seem to point to the opposite conclusion. Where the social environment is rich and diverse in content, there those with the best native endowments stand out most prominently.

It is not easy to find exact evidence bearing upon the point. An experiment made by Starch, however, is relevant in this connection. He selected eight children at random and set them problems in multiplication. After a number of trials he picked out the three best, who averaged 39 correct solutions in ten minutes, and the three poorest, who averaged 25 correct solutions in the same time. He then gave them all an equal training, in the course of which they all did 700 examples. During that time the three best gained on the average 45, while the three poorest gained only 26. In this case equality of training increased the initial differences.

The point is of very great importance in connection with varying endowments of differ-

ent human racial groups. Many attempts have recently been made to measure the average intelligence of negroes and to compare negroes in this respect with white men. The results show clearly that the average negro is not as intelligent as the average white man, but the difference does not seem to be very great. Nevertheless, though the difference may not seem to be very great when measured by some scale, showing perhaps that the average negro has 90 per cent. of the intelligence of the average white man, the effect of such a difference may be greater than appears at first sight. It may be that the apparently small superiority of the average white man enables him to make more than proportionate acquirements from the social environment. It may even be that his superiority enables him to achieve and maintain the complexity of modern civilisation, whereas the negro is unable to do so.

CHAPTER V

HEREDITY AND ACHIEVEMENT

The discussions in the previous chapters provide material with the help of which some conclusions may be reached as to the importance of heredity to the individual, and as to the part played by heredity in individual achievement. These are different problems. Let us take the first problem to begin with. It does happen that in every-day conversation we often strip off men's social acquirements and think of them and compare them as "men." We can and do think of a clerical worker and a farm labourer, let us say, as "men"; we subtract their obvious acquirements. What part does inheritance play in producing the differences that we observe between men judged as "men"?

Investigations have shown that differences in bodily characteristics such as stature and eye colour are due in far greater degree to inherited than to environmental differences. Environment may not account for more than 5 per cent. to 10 per cent. of these differ-

ences. Some characteristics, such as eye colour, may be almost wholly unaffected by the environment; whereas others, such as muscular development, are more susceptible. Exercise can increase muscular development, and the muscles of the farm labourer are more exercised than those of the sedentary clerical worker. Common experience, however, tells us that we are born rather than made muscular by exercise and training, and investigation shows it to be improbable that more than 10 per cent. of differences in muscular power actually observed are due to environmental differences. Differences in health are also more determined by heredity than by environment. Environment plays, however, some considerable part in physical well-being, and the clerical worker living under conditions where ventilation is poor and sunlight deficient does not on that account experience the same degree of physical well-being as those more fortunately situated.

Social acquirements do not complicate comparisons made between one man and another in respect of their bodily characters. They do complicate the situation when mental characters are under consideration, because even when the easily detachable acquirements have been stripped off, as they are stripped off when clerical workers and farm labourers are compared as "men," there still inhere in their mental character-

istics as observed certain social acquirements. It is difficult to judge intelligence otherwise than through the medium of words. The farm labourer has acquired a smaller vocabulary than the townsman, and different mental habits. The best designed intelligence tests are not free from error on this account. But, as has been seen, there is evidence that differences in the social environment do not obscure innate differences. Native intelligence and natural assertiveness show up and shine through these social acquirements. If we compare a farm labourer and a clerk as "men," we conclude that one is, perhaps, assertive, pugnacious, inquisitive, or intelligent compared with the other. These judgments, there is good reason to believe, are judgments of their characteristics little moulded by differences in social acquirements. Intellectual and emotional characters so estimated are thus in the main the product of inheritance and the physical environment. They are determined by the nature of the nervous system, which is the bodily substratum of the mental characters. And in the building up of the nervous system, as in the case of other bodily organs, heredity plays a larger part than the physical environment, accounting for perhaps 90 per cent. of the differences between men.

To the individual as a "man" inheritance is thus of far more importance than environ-

ment. What part does inheritance play in a man's achievement? When attempting to answer this question, the huge range of the inherited differences between members of the same community must be grasped and borne in mind. Among the inhabitants of this island there is no small number of persons so mentally deficient that they are wholly unable to care for themselves. If all men were equally inadequately endowed with native intelligence the human race would not maintain its position. It would not be able to defend itself against other animals and would rapidly perish. There are other members of the community whose intelligence is so high that it appears divine rather than human. The hereditary equipment of men in respect to their emotional and also their bodily characters is equally diverse. Modern investigations combine to emphasise the vast range of these inherited differences between members of the same community. It is an indisputable fact and one of the first importance.

How then do these differences in native endowment affect the achievements of individuals? There are achievements which are due to bodily characteristics alone. Such, for instance, are performances in athletic sports. Performance in that field, in the hundred yards race, for example, is dependent upon a man's physical constitution, which in

turn is dependent far more upon inheritance than environment. A man is born an athlete. But, it may be said, an athlete may meet with an accident, break his leg, perhaps, and never be able to perform again. Such an incident, however, is not normal. It must always be remembered that, when it is said that inherited differences are more important than environmental differences, environmental differences that normally occur as between the experiences of different men are alone under consideration. And such differences are of much less importance than inherited differences.

The mention of achievement, however, brings to mind mental rather than physical performance. A man who becomes a famous mathematician or a great doctor is said to have a big achievement to his credit. Now mental achievement is made within the social environment. It is judged by the effect it has upon the social environment. The social environment consists of an accumulation of knowledge, habits and customs to which each generation makes its contribution. The amount accumulated piles up; one generation begins where the last left off. One generation of biologists discovers the outline of the sexual process described in an earlier chapter, another fills in the details and discovers the chromosomes and their behaviour. The human race is building up

the social environment somewhat as though it was engaged in the construction of some huge building. The present generation is occupied in the construction of a floor above that completed by the last generation.

It follows that a man's achievement judged absolutely is no guide to his innate mental capacity. It is no evidence that because a man discovers chromosomes he is mentally superior to the man who in the previous generation discovered the outline of the sexual process. How do we compare with the ancient Greeks? If we had their athletic records, we could compare our times for the hundred yards race with theirs, and the differences, provided that the races were run under similar conditions in all cases, would represent innate differences in physical endowment. But answers to examination papers in biology written by young people of twenty would afford no guide to mental endowments. Our young people have access to a much richer social environment and can in a sense make a much better performance.

If absolute mental achievement is no guide to innate endowment, is relative achievement a guide? If different men have the same facilities of access to knowledge, will the different uses they will make of it correspond to, and form a measure of, their innate endowments? The evidence goes to show that under these circumstances innate differences

will not only be brought out, but even exaggerated. It would seem that small innate differences make possible more than proportionate differences in acquirements.

It does not, however, follow that all those with considerable mental capacity will make considerable mental achievements. High achievement is a sign of high capacity relative to those who have had the same opportunities, but not necessarily to others who have not had the same opportunities. Let us return to our metaphor. The human race is, as it were, constructing a building. The Greeks were engaged with the first floor, and our achievements many stories up are no guide to our innate mental equipments compared with those of the Greeks. Now it might appear at first sight that we were all engaged on one of the upper floors, and that our achievements do form a guide relatively to the performances of our contemporaries. But in fact we are not all engaged in construction. To very few comes the opportunity of laying bricks and raising the height of the building. Most of us are occupied carrying up bricks, painting, dusting and keeping the existing building clean. Therefore, while good workmen alone will lay bricks well, only a few have the chance of showing that they have the innate capacities for becoming good workmen.

To put the matter in another way, it would be possible by segregating all those with

brown eyes to select out of the population all those with genes determining brown eyes. But it would not be possible to select out of the population, as things are, all those with genes for high mental capacity by segregating those with high achievement to their credit, because there are many persons who have not had the chance of showing whether they possess such capacity. As things are, eye-colour genes show up; genes for intelligence do not necessarily show up in the form of actual achievement. Achievements physical or mental above the average will only be made by those with endowments physical or mental above the average. Heredity makes mental achievement possible; it does not ensure it.

The discussion has led us to another field of inquiry. How far are the achievements of different groups due to differences in innate capacities? We must inquire into the extent to which different groups are differently endowed, and we may first compare different racial groups one with another, and afterwards different groups and sections within the same community with the general average of that community. Some estimate can thus be formed as to how far, if at all, sections of the population such as criminals or paupers differ from the rest of the population, and thus what part is played respectively by opportunity and heredity in determining achieve-

ment. Information as to the distribution of inherited differences will also prove to be of the greatest importance when in a later chapter we come to consider racial changes, because facts are in some cases available as to the relative rates of increase of these groups.

CHAPTER VI

THE DISTRIBUTION OF INHERITED QUALITIES

Something may first be said regarding the main groups of mankind. The physical differences which they exhibit have been carefully studied and tabulated by anthropologists. It is evident that these differences are due in the main to differences in the innate endowment. Children of white parents born in the tropics are not black. The moulding influence of the environment is small. White men living in the tropics become pale owing apparently to a growth in thickness of the epithelium which prevents the blood vessels showing through the skin. Otherwise normal environmental influences exact no great moulding power. Exceptional influences which are sometimes brought to bear, such as the binding up of the feet by the Chinese or the compression of the head by some Indian tribes, can and do produce much more important effects than the normal environment, which alone is under considera-

tion here. Broadly speaking the bodily differences that we see between the white, black, yellow and other races are due to differences in innate equipment.

More important perhaps are certain physical differences which casual inspection does not reveal. There is evidence, for example, that the members of these groups are not equally susceptible to the same diseases. Some figures were quoted in Chapter III leading to this conclusion. There is much similar evidence. The incidence of pneumonia in the United States has been carefully studied. It would appear that pneumonia is prevalent under certain climatic conditions, where low temperature and high humidity are combined, and while occupational factors and age distribution play a part, nevertheless the pneumonia death-rate everywhere runs much higher among the coloured than among the white population. Though the interpretation of any one piece of such evidence may be doubtful, owing to the absence of exact knowledge as to whether the different elements in the population were equally exposed to infection, there can be little question but that the large racial groups are differently endowed in respect to susceptibility to the same diseases.

Mental differences are of more interest and of greater importance. Many careful studies have been made in the United States

designed to discover what differences there are between the white and the coloured elements in the population in respect of intelligence. These studies encounter very great difficulties. All that was said in a former chapter regarding the difficulty of finding a measuring rod which will measure with equal accuracy the intelligence of two groups of persons who have not experienced the same social environment applies with much greater force to such studies as these. It is impossible to do more here than to quote the results of one of these investigations. Ferguson tested the intelligence of 486 white and of 421 coloured children in certain schools. The coloured children were divided into four classes, full-blood negro, three-quarter negro, half negro (mulatto), and quarter negro (quadroon). It was found that "the pure negroes scored 69·2 per cent. as high as the white; that the three-quarter negroes scored 73·2 per cent. as high as the whites; that the mulattoes scored 81·2 per cent. as high as the whites; and the quadroons obtained 91·8 per cent. of the white score." The results of the various investigations which have been made are by no means all concordant. While it is not apparent to what exact degree the negro is inferior in intelligence to the white man, there is no doubt that he is on the average inferior. Professor Thorndike, whose authority stands

high in these matters, puts the difference at from 5 per cent. to 10 per cent.

The few investigations that have been made exhibit no differences of any moment in intelligence between the other great human groups, between the yellow and the white, for instance. But the possibility of mental differences does not end with differences in general intelligence. Groups may differ in respect of their emotional and temperamental qualities. While we have no exact knowledge of the existence of such differences, there is reason to suspect their presence in certain cases. It is likely that negroes differ more from white men in respect of these latter qualities than in respect of their intelligence. It is also likely that there are temperamental differences between a yellow race, such as the Chinese, and European races.

When we come to consider the smaller groups, the English, Irish, French and other European "races," and to compare them in respect of their innate mental endowments, we find exact information to be almost wholly lacking. There does not seem to be any reason to suppose that they differ in respect of general ability. But there is a widespread impression, and in the absence of methods of measurement and their application it can be no more than an impression, that there may be differences in the posses-

sion of specialised abilities, and that there are almost certainly emotional and temperamental differences. Everyone realises the differences between the Irish and the English as a whole, difficult as it is to describe them adequately. After making all allowances for the influence of the social environment, it would seem that inherited differences must in large part account for them.

It is impossible to find space here to discuss at greater length these important problems. Further, we are moving in regions of such uncertainty that it must obviously be a matter of the greatest difficulty to decide what conclusions should be drawn from the innate differences between these groups, large and small, that we may suppose to exist. To what degree are the achievements of the negroes, the white and yellow races respectively due to the possession of particular innate qualities? What place, if any, are we to give to innate factors in moulding the history of England and Ireland? These questions are of such interest and importance that we cannot altogether pass them over. They are, however, more conveniently discussed in a later chapter, when we can take into consideration such agencies as are known or as are suspected to have brought about changes in mental characters. To this later chapter are therefore left these problems of the achievement

of racial groups in history, and attention may now be paid to problems concerning the distribution of inherited qualities in this country at the present time.

Physical characters may occupy our attention first. From what has been said above it follows that the huge differences in physique between men that are visible on every side, when not due to exceptional environmental conditions, say accident causing the loss of a limb or serious disease, are due more to inheritance than to environment. Some idea of the extent and relative prevalence of these differences may be gathered from the reports of the Medical Service Boards, which between November 1917 and November 1918 examined 2,425,184 men of military age. The men examined did not form a true average sample of the population, because a large number of the fitter men were already serving. These men were classified into four categories: (1) full normal health; (2) moderate muscular development and able to undergo a considerable degree of physical exertion of a nature not involving severe strain; fair hearing and vision; no progressive organic disease; (3) marked physical disabilities such as severe flat foot; not fit to undergo much physical exertion; (4) totally and permanently unfit for military service. The men examined were classed as follows: Grade 1, 36 per cent.; Grade 2, 22 to 23 per cent.;

Grade 3, 31 to 32 per cent.; Grade 4, 10 per cent. In other words, out of every nine men of military age examined during this period three were perfectly fit, two were more or less infirm, three were incapable of more than a very moderate amount of physical exertion, and one was a chronic invalid. It is evident that not only are there great differences in physique between men in this country, but that those exhibiting extreme degrees of physique, good or bad, do not form a negligible proportion of the whole.

The problem is whether these differences are distributed at random or not throughout the population. Information derived from the same source as before throws some light upon this problem. Men from the county of Yorkshire between the ages of eighteen and twenty-five were classified according to their occupations and to their grades of physical fitness.

YORKSHIRE MEN AGED 18-25

Occupations.	Grades.			
	1.	2.	3.	4.
Miners	72·7	12·2	11·0	4·1
Agriculturists	69·6	17·2	9·9	3·3
Engineers	60·9	23·9	13·4	1·8
Iron and Steel Workers	60·2	25·6	11·2	3·0
Woollen Trade	46·1	21·3	25·5	7·1
Lace Trade	45·0	26·9	22·7	5·4
Tailors	33·9	21·4	33·5	11·2

Clearly enough the miners and farm labourers are the most physically fit; only 15 per cent. of the miners fall into Grades 3 and 4, whereas nearly 45 per cent. of the tailors are found in these grades.

The Committee reporting upon these data went on to construct an index of fitness. They reckoned a Grade 1 man as a full unit, Grades 2, 3 and 4 men as three-quarters, half and quarter of a unit respectively. Agriculturists and miners came out top with an index of nearly 90, and tailors at the bottom with an index of a little under 70. The Committee comment upon these results in the following words: "It can hardly be doubted that the gradual fall in the index of fitness shown in this table is a true criterion of the effects of the various occupations upon the physical welfare of the workers. They correspond to what we know of the conditions of life in the several trades and their accepted effect upon health too clearly to be explained by the hypothesis that the agriculturist is an agriculturist because he is healthy, and the tailor a tailor because he is unhealthy. This may be true to a certain very limited extent of certain trades and industries."

In the view of this Committee the physical differences between the persons pursuing these different occupations are to be attributed to the effect of the mode of life entailed by these occupations. The discussions in a former chapter as to the moulding power of the

environment would not lead us to expect that such large physical differences can be so produced. Doubt is thus raised as to the correctness of the Committee's interpretation of these data. The data, as they stand, however, do not permit of any further analysis. What other facts are available to throw light upon the point? If we had measurements of the physique of the children of miners, tailors and of those following the professions mentioned above, all taken at the same age, the problem would be in a fair way to solution. If the children were measured while they were at school, and if they showed differences of the same order as those shown by the parents, then, since these children had not at the age at which the measurements were taken begun to follow an occupation, the differences could not be attributed to the effects of different occupations. Unfortunately such information is lacking. But there is information of a somewhat similar nature which is relevant to the problem.

Measurements of the height and weight of school-boys in Liverpool of different ages have been taken. These boys came from schools of four different grades: (1) Secondary school; (2) Council school in a good neighbourhood; (3) Council school in an average neighbourhood; (4) Council school in a poor neighborhood. The figures are as follows:—

STATURE OF LIVERPOOL SCHOOL-BOYS

Class of School.	Average Height in inches of Boys aged		
	7.	11.	14.
	ft. in.	ft. in.	ft. in.
Secondary School . .	3 11·4	4 7·5	5 1·75
Council School, good neighbourhood	3 9·33	4 5·11	4 10·2
Council School, average neighbourhood . .	3 8·8	4 3·8	4 8·25
Council School, poor neighbourhood	3 8	4 1·75	4 7·25

At each age the boys from the superior schools are taller and also heavier. The differences are very marked. At the age of fourteen the boys from the secondary school are six inches taller than the boys from the school in the poor neighbourhood. These differences cannot be attributed to the effect of occupation, because the boys when measured had not entered upon any occupation. Can they be attributed to differences in home environment? There are undoubtedly large differences between the environment to which the boys in the different classes of school have been subject. The boys from the secondary school have better and more regular meals at home; the conditions under which they have been brought up are in general healthier; they get more exercise and more fresh air and are

better clothed. Are these environmental differences able to produce the physical differences observed? Modern investigations summarised in former chapters make it very unlikely that these differences can be attributed to the surroundings. It is necessary to speak with caution. There is no doubt that, in general, differences in the environment play but a small part in producing the physical differences that we observe; our knowledge, however, of the extent to which particular organs or particular physical characters can be moulded, and of the extent to which particular aspects of the environment can exert moulding power, is at present so limited that, confident as we may be as to the position as a whole, it is unwise to be dogmatic when we come to details. Evidence has lately come to hand showing that stature is somewhat more susceptible to environmental influences than was formerly thought to be the case. Nevertheless, such great differences as those which are exhibited by these children are in the main almost certainly inherited differences.

These data do not enable us to work out the correlations between the height of the children and the occupations of the parents. But it is known in a general way that the occupations of the parents of the children in the different schools are different; the parents of children in secondary schools belong, for the most part, to the professional classes, those of

children in Council schools Grades I, II and III belong for the most part to the small shopkeeper and higher artisan class, to the labourer in steady employment and to the casual labour class respectively. The evidence points to the conclusion that these classes are not equal in respect of their bodily endowments. How then does this unequal distribution of physical characteristics come about?

An extensive knowledge of existing social conditions in this country is not necessary to show that the entry into different professions is to some extent selective. Under the Factory and Workshops Act young persons under sixteen can only be employed in factories if they have a certificate of fitness from the certifying surgeon of the district. It is true that under this Act a very small percentage of applicants are rejected. Much more important is the selection which goes on by reason of the fact that many of those who have entered an occupation are unable by reason of physical disability to maintain themselves in it. Figures are not available, but many examples must be known to those who have had personal contact with work-people and their families. Occupational selection is by no means confined to the less well-paid occupations. Would-be entrants to the Civil Service are medically examined, and many companies require a medical certificate before candidates for the better-paid posts are

accepted. Here again among these higher-paid occupations innate physical disability probably tells more often in preventing a man from improving or maintaining his position than in putting an absolute bar to entrance. Wherever we look we see selection on account of innate physique at work. Only men of exceptional physique can stand the strain that is placed upon a Prime Minister in these days, and all those who in recent years have held the premiership for more than a short time have been of very much more than average strength. We may conclude that the inheritance of physical characters has no little to do to-day with achievement. There is, however, a lamentable lack of detailed knowledge. What differences do exist in respect of inherited characters between the members of different occupations and professions? What happens to those who fail to enter or to maintain themselves in the profession of their choice? In districts which are predominately mining or agricultural what happens to the less physically fit, assuming, as is apparently the case, that mining and farm work demand more strength than other occupations? To these and many other similar questions there is at present no answer.

Mental characters must now occupy our attention. How far are mental characters also unequally distributed? In the fourth chapter the results of an investigation made

by Mr. Cyril Burt were quoted. It will be remembered that he employed intelligence tests to measure the intelligence of children in two schools, both situated in the same borough, one in a good and the other in a poor area. The children in each school considered separately showed a very wide range of intelligence. Our discussion of the rôle of the environment in producing mental differences leads us to conclude that since the environment of all the children in the school in the good neighbourhood is fairly similar, the mental differences exhibited by them must be for the most part innate. The same may be said of the differences between the children in the school in the poor neighbourhood.

When the children in the two schools were compared, it was found that those in the school in the good neighbourhood were very distinctly superior to those in the poor neighbourhood. The measuring rod employed, the system of tests, that is to say, is defective in that it measures not merely the naked intelligence but the intelligence shaped in some measure by the social environment. The following problem thus arises. Does this measuring rod give unduly high values for the intelligence of those who have been brought up under a particular form of social environment? The analysis of these tests made in the fourth chapter suggests that this method does favour unduly those children who have been brought

up under a good environment. Is it reasonable to conclude, it may next be asked, that the allowances which it is necessary to make for those brought up under the less favourable environment are so large that the differences between the two groups would disappear?

When answering this question, account must be taken of the fact that similar investigations have been made with different forms of tests. To quote only one example. Pressey and Ralston in America tested children the occupations of whose fathers were known and classified in four groups. They give the following table classifying the children according to the occupation of the father, and showing the percentage of children in each group above the median for the entire group.

Group.	Ages.					
	10.	11.	12.	13.	14.	Combined.
Professional	93	85	80	81	86	86
Executive .	58	44	56	76	68	68
Artisan .	52	32	48	38	40	41
Labourer .	38	41	39	34	40	39

The percentages of children in each occupational group who make scores in the highest and lowest ten per cent. for their age are as follows:

	Professional.	Executive.	Artisan.	Labourer.
In highest 10 per cent. . .	41	10	8	6
In lowest 10 per cent. . .	1	2	12	17

It is well worthy of note that all these investigations, whatever tests are used, rate very distinctly more highly the intelligence of children of higher than that of the children of lower social status, whether social status is measured, as in this case, by the profession of the father, or, as in the former case, by the neighbourhood in which the family lives. It is certainly of some significance that, whatever the test used, the difference is marked. So also is the conclusion to which we came from certain lines of evidence that such differences in the social environment as exist in a country such as England do not mould mental characters to any very marked extent.

Taking all the considerations into account, it would appear that the tentative conclusions to be deduced from them are somewhat as follows. There are innate differences between the average level of general intelligence among the members of different social classes and occupations. These differences, while by no means unimportant if, as we shall find to be the case, the members of different classes and

occupations increase at different rates, are trivial when compared with the vast differences which exist between the members of every class and profession. Given the huge innate differences which exist between the members of the population as a whole, society might be so constituted that the ablest members all followed certain occupations, the least able quite other occupations, and those of intermediate ability occupations holding a half-way place in the social scale. This segregation has not occurred. There is some evidence of the first step towards it; that is all. This conclusion is in agreement with that of the greatest authorities in this field at the present day. Mr. Burt says, for instance, when dealing with "hereditary differences of race, sex and social class": "The main conclusion that can be drawn from experimental work is, I think, the following: innate group differences exist; but they are small."

General intelligence is associated with specific abilities, mathematical, manual, literary and others. It therefore follows that if the members of certain professions and classes are superior to others in general intelligence, they are also superior in regard to their specific abilities. There is, however, very little association between the intellectual and emotional qualities. It thus follows that evidence of innate intellectual differences between the classes and occupations is not evidence of

innate emotional differences. There is as yet no evidence derived from experiment which throws light upon the problem of emotional differences between these sections of the population. But emotional differences are at least equal in importance to intellectual differences. Let us then glance at existing social conditions and ask, just as we asked when dealing with physical characters, whether segregation on account of intellectual and emotional differences seems to be at work. Evidence of the existence of segregation on account of intellectual differences would go to confirm the impression derived from experimental evidence, while evidence of segregation on account of emotional differences would suggest that emotional as well as intellectual differences exist between different sections of the population.

Everyone is aware of the barriers in the shape of examination and similar tests which hedge round the entry into the professions. Under the latter term are included the legal, medical, teaching and administrative professions, and also the now very numerous smaller professional groups, such as architects, accountants, applied scientists and many others. "Business" occupations not falling under one of the above definite groups are excluded. The barriers which have to be crossed are first encountered at an early age. The outlines of the scholarship system from

elementary school to secondary school, from secondary school to university, and of the university examination system are familiar to all. Further barriers are met with in the form of specific tests which many professions set up. A certain not inconsiderable proportion of would-be entrants to the professions fall at one or other of the various hedges, and without doubt those who manage to set their feet on the bottom of the professional ladder are on the whole abler than those who fail.

There is here a process of selection among a number of starters. Success falls on the whole to the abler. The process tends to sort out the more from the less intelligent. It should not be forgotten, however, that to some degree the possession of certain emotional qualities is no small aid to passing these barriers, which appear at first to impede the less intelligent only. Those innate emotional qualities which are the foundation of ambition, perseverance, resistance to fatigue, "grit," are no small aids to success even in this field. Since emotional qualities are but little associated with intellectual qualities, there is no doubt that many of the successful are less intelligent than some of the failures, but possess emotional qualities which for this purpose in any case are valuable and compensate for lack of intelligence. Much the same may be said of success within the professions; while success goes on the whole

to the most intelligent, we can all recall examples showing that perseverance and similar temperamental qualities have brought a man to the top of the tree. There is one other consideration of importance. In some professions, though to a less extent than formerly, there is a selection among the starters on account of the possession of social acquirements. So far as it is an advantage to a candidate for a Civil Service post or for a university appointment to have been at a "good" school or to have moved in social circles which make it easy to get recommendations from well-known persons, so far innate intellectual and emotional qualities are rendered of less account.

The selection of which we have been speaking chiefly occurs among those who start. There are numerous barriers which prevent many young persons, otherwise qualified, from starting because of lack of opportunity and of lack of social acquirements. Let us take one point only. It is frequently made necessary by existing regulations or customs for would-be entrants to professions to pay a considerable sum of money before they can qualify, and to spend some years in what amounts to apprenticeship, which again costs money. That is the case at the Bar, for example, and, where such circumstances exist, a premium is put upon social acquirements. Facts such as these account for the position disclosed by

experimental tests. If opportunity was equal for all, if social acquirements counted for nothing, and if examination tests were rigorously imposed, we might expect to find greater intellectual differences between the members of the professions and other elements of the population than we do find in spite of the fact that such tests sort out emotional as well as intellectual qualities.

There are included among those occupied in "business," even if we only include those receiving good incomes, persons whose work is so diverse that no generalisations can hold good of business men as a whole. A rough distinction may be drawn between the salaried persons and the owner managers who take the risk and the profits. Among the former are included some, such as applied scientists and accountants, who can also be regarded as belonging to one of the professions considered above. The remainder of this class of salaried persons may be regarded as forming a class comparable with the Civil Service. With the growth of the limited liability form of commercial organisation this latter class increases. Intellectual selection in the form of examinations does not play a large part in determining who shall form this class. But the stress which is increasingly laid upon performance at school and college indicates that selection is at work, and similarly success within the profession accrues on the whole to those with the best

innate ability. The recruitment of this class is thus to be regarded as segregating from the population as a whole those endowed with ability, and also with temperamental qualities not unlike those required in the professions.

The recruitment of the owner manager or entrepreneur class is, however, probably based on a somewhat different range of qualities. It is likely that certain emotional and temperamental qualities of ambition, pertinacity, desire to acquire, readiness to take risks and other characteristics play a larger part in inducing men to enter into and enabling them to be successful in this form of occupation than are the purely intellectual qualities. Since there is very little association between these two groups of qualities, there is no reason to think that, so far as selection is on this basis, those selected will have more than average ability. It is not meant that ability is of no advantage in this sphere, but that it may play a secondary part, just as in the case of the professions qualities other than the intellectual play a secondary part. Further, the recruitment of this class is made to no small extent upon the basis of social acquirements and advantages in the sense that men who own and control businesses not infrequently " put " their sons and relatives into the business. It is a remarkable fact, easily as it may be understood, that a business man will think it the most natural thing in the world to " put

his son into the business," whereas when he takes his place on the governing body of a school or other institution, he will insist, and quite rightly, on the most impartial and rigid examination of the qualifications of the candidate for any vacant appointment. So far as this element enters into the selection of this class, it tends to reduce the selective effect unless the sons and relatives inherit the qualities of the entrepreneur.

The professional and entrepreneur classes, however, form but a small fraction of the community. What selective processes can be observed at work in the remainder of the population? The problem could be discussed at great length, but the field has been made the subject of so little exact investigation that a passing reference must suffice here. It would probably be found that there is a fairly general agreement among those best qualified to form a judgment to the following tentative conclusions. If we divide the workpeople into a skilled, an unskilled and a casual class it is likely that there are innate differences between the groups. These differences may be more marked in respect of emotional than of intellectual characters. While intellect is always of advantage, and especially so in some skilled occupations, it is not of great advantage in other so-called skilled occupations. If there are innate differences between bricklayers and bricklayers' labourers, they are likely to

be temperamental rather than intellectual. Those temperamental qualities which are the foundations of trustworthiness and steadiness probably do more to determine whether a man shall take his place in the casual or in the skilled class than do intellectual qualities. While men with defective intelligence do drift into the casual class, it seems more common to find that recruitment is from among the shiftless, unreliable and unstable types. These tentative conclusions are in harmony with such experimental evidence as there is derived from measuring the intelligence of the children of the skilled and of the unskilled, showing small differences between the groups. We may perhaps expect that when methods have been devised to measure emotional qualities, larger differences will appear in this sphere.

It is also possible that occupations may be selective quite apart from the skilled or unskilled nature of the work. It is, for instance, often asserted that the " best men " tend to leave agriculture and drift to the towns. Of this there is no exact evidence. Once again the need for inquiry is urgent.

CHAPTER VII

THE DISTRIBUTION OF INHERITED QUALITIES (*continued*)

In the last chapter the larger groups of mankind were first compared in respect of their innate endowments. The various sections into which the members of our own community in these islands may be classed were next similarly compared. It emerged that, while there are differences between the average endowments, mental and physical, of these groups, these differences are small when compared with those vast differences which are known to exist between members of the same group or section of a group. Similar inquiries can be made into the endowments of various elements in the community, and these endowments can be compared with those of the rest of the population. The problem of the criminal element in the population may be taken first.

Crime.—The very valuable and comprehensive work of the late Dr. Goring enables us to speak with more assurance about the part played by heredity in crime than is possible with regard to other social problems. He

studied data referring to 3000 English convicts. These data included detailed anthropological measurements and full particulars of the crimes committed, and of the previous history and experiences of the convicts. Some of his principal conclusions may be summarised as follows.

Different kinds of criminals were compared with each other, and criminals as a class were compared with the law-abiding public in respect of many physical characters. From these comparisons no evidence has emerged confirming the existence of a physical criminal type such as has been described by Lombroso and his school. It would appear that there is no such thing as a physical criminal type. In other words, if the inhabitants of a city were made to file before an anthropologist he would not be able to pick out the criminals by reason of the fact that they exhibit certain recognisable anthropological characteristics.

This conclusion is not to be read as meaning that criminals do not differ from the general population in respect of physique. The mean stature of this sample of criminals was 65·5 inches, whereas that of the general population is 67·2 inches. The criminals were also below the average weight. In this sample of criminals the professional, commercial and selected (soldiers, policemen, messengers, servants) classes were represented in a proportion higher

than that which they bear to the population as a whole. Therefore the deficiency in the height and weight of the criminals is not due to a relative excess among them of persons drawn from those classes which are below the mean of the general population in physique. If the criminals are divided into classes according to the type of offence committed, it is found that those who are technically convicted of fraud are of about the average height and weight, while those who are convicted of violence to the person are characterised by a degree of strength and of constitutional soundness above the average of other criminals and of the law-abiding community.

Similarly, with regard to mental characters, it does not appear that criminals are stigmatised by the possession of special characters. But taken as a group they exhibit defective intelligence when compared with the population as a whole. If the group of criminals is divided according to the type of crime committed, it appears that whereas about 1 per cent. in the general population is defective, 52·9 per cent. of those convicted for stack firing, 16·7 per cent. of those convicted for arson, 12·8 per cent. of those convicted for fraud, 5 per cent. of those convicted for manslaughter are mentally defective. Among those convicted for embezzlement, forgery, fraudulence as trustee, bigamy, performing illegal surgical operation, none was mentally

defective. It thus follows that, as in the case of physique, while the criminals were as a whole below the average in intelligence, some classes of criminal were very much below the average, while others showed no greater incidence of mental defect than is found in the general population. In addition it may be noticed that extreme forms of alcoholism, epilepsy, insanity and sexual profligacy were also found to be significantly associated with the committing of crime, and that these conditions, together with defective physique and defective intelligence, are the only conditions so associated which are or may be constitutional.

Dr. Goring also measured the association of conviction for crime with a variety of environmental conditions such as illiteracy, parental neglect, lack of employment, stress of poverty, early age at death of mother, size of family and others. He found no definite degree of relationship between any of these environmental conditions and the committing of crime. When, however, he came to measure the association between parents and offspring in respect of crime he found a correlation of about ·6.

What is the part played by heredity and environment respectively in the production of criminals in the light of these investigations? Criminals are not marked out from the general population by easily recognisable innate characteristics. But they are on the average

below the general level of physique and intelligence of the population. To illustrate the position Dr. Goring uses this figure. A certain proportion of persons in the general population—let us call it one in x—are convicted at some time of life for indictable offences. Let the adult population be made to file by in groups of x, and let out of each be chosen the person who happened to be the smallest in stature or the most defective in intelligence, it would then be found that the band of individuals so chosen would in physical and mental constitution approximate more closely to the criminal population than the residue. Further analysis, however, shows that whereas certain forms of crime are markedly connected with defective physique, theft, for example, violence is associated with physique above the average. Similarly, the degree to which different forms of crime are associated with mental defectiveness varies; those convicted of embezzlement, for example, are not below the average in intellectual development.

It would appear that poor physique and in greater degree mental defect are constitutional factors which tend to predispose those who possess them towards crime. Obviously this is not the whole explanation. We may ask whether there are not other constitutional factors. We may ask what part is played by the surroundings. As noted above, Dr. Goring found a marked degree of association between

parents and offspring in respect of conviction for crime. Criminals do not appear equally in all families of the general community; they tend to be restricted to particular stocks or sections of the community. Is this association to be attributed to example, to upbringing in a "criminal" atmosphere, or to the inheritance of some constitutional factor tending towards crime?

If this association is due to evil influences permeating family life, we should expect to find the association stronger where example is most likely to be followed. Stealing and burglary are "professional" crimes and could be learnt. "We can understand," says Dr. Goring, "the influence of parental training in the moulding of a professional burglar or thief, and, to a certain extent, it is conceivable that the constant spectacle of lack of control in parents might lead their offspring to emulate them in acts of unlawful violence. But, that parental example could play any part of importance in the perpetration, by their offspring, of crimes such as arson and wilful damage to property, and particularly of sexual offences, is not reasonably to be supposed. The parental correlation for sexual crimes, and crimes of wilful damage to property, is from ·45 to ·5; for stealing it is from ·48 to ·58. We would assume then, from this evidence, that the intensity of the inherited factor in criminality is from ·45 to ·5, and the

intensity of criminal contagion is anything between ·05 and ·1." This conclusion finds support in the fact that, since paternal and maternal correlations in crime should be equal, any excess of the correlation coefficient of one parent over the other should express a minimum value for the influence of contagion or example. The difference averages about ·05 and corresponds to the minimum value given above.

The low values which Dr. Goring obtained when he tested the degree of association between various aspects of the environment and crime do not for various reasons, as he himself says, show conclusively that social and economic conditions are unimportant. The conclusion suggested, namely, that they are not of great importance, is supported by further analysis of the data, which show that particular social conditions such as unemployment and poverty are not connected with the commission of certain forms of crime rather than others. If these social conditions did predispose those who suffered from them to commit crime, we should expect to find that particular social conditions predisposed men to particular forms of crime. We might expect, for example, that poverty would lead to acquisitive rather than to sexual offences. We might expect that unemployment would be associated with certain forms of crime rather than others. That there is no evidence of such association

means that if social condition, unemployment, for instance, does predispose men towards crime, it predisposes them equally to all forms of crime. This is certainly very unlikely.

These considerations suggest that there is another constitutional factor at work. Defective physique and defective intelligence play some part, but, since certain crimes are committed by persons with more than average physique and others by those of at least average intelligence, there is no close and consistent connection between these innate qualities and the commission of crime. We can measure physique; we can measure intelligence, at least up to a point. We cannot yet measure in any satisfactory manner what Mr. Burt calls emotionality. While it cannot be proved, it may very likely be that criminals on the average differ from the general populations in respect of their innate emotional constitution. They may be emotionally peculiar in that they are socially defective and emotionally unstable. They may be so constituted as to feel less responsibility towards their fellowmen than is felt by the rest of the population. The experience of those having to do with criminals seems to lend support to this suggestion. So far as this is so, so far we may say that the inheritance of certain qualities probably plays an important part in predisposing men to crime—a larger part, perhaps, than is played by circumstances.

Alcoholism.—The literature which has gathered round the problem of alcoholism is very large; only a small proportion of it, however, is of any considerable value. In addition to the fact that much of it is presented in a very unscientific fashion, there is always the difficulty of defining a character such as alcoholism. It would appear that two conclusions have been established beyond any possibility of doubt. The first is that alcoholism runs in families. As evidence of this there are the numerous pedigrees showing that there is in certain families a higher proportion of alcoholics in each generation than in the population as a whole. The correlation between parent and offspring has been worked out and found to be high. The second is that alcoholism is associated with mental deficiency, insanity, crime, epilepsy and nervous disorders. There does not appear to be any relation between alcoholism and physique.

The interpretation of these facts has given rise to controversies sometimes of an acrimonious nature. It is always to be remembered that association between parents and children in respect of any characteristic is not in itself a proof of inheritance. Further, it is not necessary to suppose that if heredity has anything to do with the problem it inevitably takes the form of the inheritance of an irresistible passion for alcohol. It may very

well be that there are certain innate characters which, things being as they are, may predispose those who possess them to exhibit lack of control in various directions, sometimes in one direction, say alcoholism, and sometimes in another. The manifestation of these characters would thus vary in nature and amount with social conditions according as to the nature of the outlets for lack of control that might exist.

The accumulation of pedigrees does not enable us to get any nearer to a solution. The method followed by Stocker, working upon data from an institution at Erlangen in Germany, is more promising. He investigated the histories of the cases of alcoholic delirium confined in this institution. His object was to find out all he could about the early history of these cases and about the relatives. He obtained well-authenticated and detailed facts for ninety of the hundred and fifteen cases represented in the institution. Thirty-four of the ninety were epileptic, and the epilepsy had manifested itself in thirty-two of the thirty-four cases before alcohol had begun to be taken in excess. Of the remaining cases the large majority had exhibited symptoms of nervous or mental derangement before the alcoholic habit was acquired. There was evidence of nervous derangement among the close relatives of most of these cases. Similar close investigations of family histories,

of the notorious Jukes family, for instance, show that mental disorders usually manifested themselves before the alcoholic habit was acquired.

Such evidence suggests that alcohol is not the cause of mental derangement and that the explanation of alcoholism as an acquirement following upon the inheritance of some constitutional mental or nervous weakness fits the facts much better. Other evidence supports the same view. Heron found that there was a close connection between alcoholism and mental defect, but that the amount of mental defect among those who had been drinking for many years was only slightly greater than among those who were only just starting upon their alcoholic careers. Bearing in mind that the greatest caution is necessary where the data are so difficult of interpretation, it seems that the indications point to conclusions somewhat as follows. It is possible that mental instability and nervous derangements may be inherited, but that the form in which they manifest themselves may take different shapes. There is some evidence that suicide runs in families, but we should hesitate before interpreting such evidence, if it was established, as indicating the inheritance of a specific tendency to commit suicide. It is more reasonable to suppose that lack of self-control is inherited and that it may result in suicide, and is likely

so to manifest itself in a family some member of which has previously committed suicide. A mentally unstable member of the family brooding over the family misfortunes would be more likely to commit suicide than a similarly afflicted member of a criminal or alcoholic family, who would be more likely to take to crime or drink respectively. It may be noted that if we accept this view we should not attribute crime to alcoholism, but that we should interpret the association between them as arising from the fact that mental weakness sometimes shows itself in one fashion, sometimes in the other and sometimes in both. Thus in all probability heredity plays a not unimportant part in the problem of alcoholism.

Unemployment.—The total volume of unemployment is known with less accuracy than appears at first sight. The published figures are an indication of the relative rather than of the absolute amount of unemployment. They show that the amount of unemployment varies very greatly over a period of years. The percentage of unemployed among the members of the Trade Unions making returns varied during the forty years before the war from a little over 2 per cent. to about 11 per cent. These variations are to be attributed to those causes, whatever they may be, which account for trade cycles. It is to be observed that, however brisk trade

may be, unemployment never falls below a certain percentage of those engaged in industry. The industrial machine so works that, however well it functions, there are always some persons unemployed.

It is possible that if everyone was equally well endowed and well equipped there would still be nearly as many unemployed as now. Unemployment is not primarily a problem of heredity; it is a problem of industry. The remedy is to be sought in better industrial organisation. Nevertheless heredity may play a part. Is it not possible that those who first fall out of employment and who find most difficulty in gaining employment are the least well equipped mentally and physically? If economic circumstances impose unemployment upon a million workers in this country, is it not possible that they will not be a random sample of the population but a class somewhat below the average?

It may be so, but facts are not available upon which conclusions can be founded. There is interesting evidence such as that provided by the observations of Messrs. McG. Eager and Secretan which so far as it goes is suggestive. These authors have recently studied in some detail unemployment among boys in Bermondsey. They made no measurements of physique, but in view of their wide experience the following statements are worthy of note. "One of the

standing difficulties of finding work for Bermondsey boys is to find work for fourteen-year-old youngsters who look no more than ten, and are too small to reach the level of the bench or machine in many factories. Even when the demand for boy labour was great, the difficulty of placing them was serious. . . . The very small boy has always been a problem." These authors go on to speak of the members of the boys' clubs, and say that "even after making liberal allowance for the frequency of very small boys in the particular districts from which the members of our clubs are drawn, the prevalence of undersized and in other ways handicapped boys among those out of work is striking." The same authors are of opinion that there is an intellectual as well as a physical selective factor in the problem. They analysed the standards reached at school by the boys covered by the inquiry, and found that of the boys at work over 70 per cent. had reached the top standard before leaving school, whereas of the boys out of work only 30 per cent. had reached this standard. An investigation was recently carried out by the London Juvenile Employment Committee, in the course of which particulars were recorded in respect of every tenth boy and girl on the register on the 19th July and the 13th December 1924. It was found on each occasion that about 30 per cent. of these

boys and girls were "difficult" cases on account of their being "physically and mentally below normal," which made it hard to find employment for them.

Other evidence similar to the above could be adduced, and it seems by no means unlikely that among the applicants for work the less well endowed, physically or mentally, are handicapped. It follows that, so far as this is so, the less well endowed are proportionately more numerous in the unemployed than in the employed section of the population. It appears probable that innate factors play a smaller part in deciding who shall be discharged than in deciding who shall get work. Workers are often taken on one by one but are discharged in mass. Nevertheless even here selection may come in to some extent.

Data do not exist which enable us to compare a random sample of the unemployed with the general population. A Report on an Investigation into the Personal Circumstances and Industrial History of 10,000 Claimants to Unemployment Benefit recently made by the Ministry of Labour is of interest in this connection. The 10,000 claimants were selected in such a way as to make a random sample of the whole body of claimants. They do not form a random sample of the whole body of unemployed because not all the unemployed are entitled to benefit. The persons to whom the Report relates

were interviewed by the managers of the Employment Exchanges, who among other items recorded the following. (1) Degree of employability, including (*a*) those who in normal times would be in steady employment, (*b*) those who would in normal times obtain a fair amount of employment, (*c*) those who in normal times would not obtain a fair amount of employment, but who were not "verging upon the unemployable," and (*d*) those who were "verging upon the unemployable." (2) Physique defined as good, fair and poor. (3) Health defined as good, fair and poor. (4) Physical defects.

Analysis of these data show that 66·5 per cent. of all the males and 73·5 per cent. of all the females were persons who in normal times would be in steady employment; while only 3·6 per cent. of the males and 2·0 per cent. of the females were regarded as "verging upon the unemployable." Categories (*a*) and (*b*) of employability account for 89·4 per cent. of the men and 88·2 per cent. of the women. It is worthy of note that over half the men and over one-third of the women placed in the category of those "verging upon unemployability" were sixty years of age or over. It was also found that an insignificant proportion of those placed in category (*a*) were of poor physique, whereas over two-fifths of those in category (*d*) were in that condition, and again that at the age of sixty little more

than half the claimants were described as of good health. Those "verging on unemployability" are therefore for the most part the older men and women, whose health and physique are poor. As regards physical defects, the analysis shows that 78·2 per cent. of the males and 87·6 per cent. of the females were classed as having no apparent physical defect.

This investigation, in addition to being of great interest in other respects, is relevant to our present discussion in that, while it does not permit of any comparison between the employed and the unemployed, it does show that the unemployed as a class are not stringently selected on account of health, physique and physical defect from the population as a whole. But it must be remembered that the remainder of the unemployed, those young persons who are not entitled to benefit, and those older persons who for one reason or another have fallen out of benefit, may possess a somewhat lower degree of health and of physical fitness and thus bring down the average. Nevertheless the investigation makes it clear that even if there are differences between the employed and unemployed, these differences are slight and there are no grounds whatever for considering the latter group to form, so far as health and physique are concerned, the "dregs" of the population.

Inheritance thus plays but a small part in the unemployment problem. The part played may perhaps be illustrated by the experiences of benefit societies which pay unemployment benefit. It has been observed that, while unemployment falls equally upon most of the members, there is a small percentage which suffers unduly from unemployment. This small percentage is probably composed of the less healthy and the less physically fit, and thus the unemployed group taken as a whole would exhibit less than average health and fitness.

Pauperism.—Do those who at any one time are in receipt of Poor Law relief differ from the average of that section of the population from which they are drawn? Does inheritance play a part in determining who shall constitute the pauper population? Are the remedies for pauperism to be sought wholly in schemes of social and economic reorganisation?

It must be admitted that the material at hand does not permit of any definite answer being given. Certain tentative conclusions, however, are suggested by a study of the facts available. The following table shows the total number of persons who on the 1st January 1923 were in receipt of relief, classified according to the cause of their poverty. "Children" in this table are persons under sixteen years of age.

Class of Persons.	Numbers.			
	Men.	Women.	Children.	Total.
1. Persons in receipt of relief in their homes on account of unemployment . . .	178,569	166,955	376,214	721,738
2. Persons not included in above in receipt of relief on account of—				
(*a*) Sickness, accident or bodily infirmity . .	106,320	154,465	22,696	283,481
(*b*) Mental infirmity	49,573	69,362	3,359	122,294
(*c*) Ill-health of a dependent .	4,378	1,740	—	6,118
(*d*) Other causes (including widowhood and orphanhood) .	40,172	104,011	260,176	404,359
(*e*) Total of items 2(*a*) to 2(*d*)	200,443	329,578	286,231	816,252
3. Totals: all persons .	379,012	496,533	662,445	1,537,990

At this date nearly half those in receipt of relief—seven out of every fifteen—were in that position owing to unemployment. These persons were either not qualified for unemployment benefit, had fallen out of benefit, or were supplementing benefit with other assistance. The possible influence, however, of inheritance in their case has been discussed above and they may be left out of account here. " Other causes " account for about half of the remainder. Widowhood and orphanhood are the most important of these " other causes." There is no reason to think that widows and orphans differ as regards their innate endowment from the section of the population from which they are drawn. Misfortune has caused them to have recourse to the Poor Law. Inheritance may be left out of account here. With regard to the two remaining categories of importance the position is different. Those included under the headings 2(*a*) and 2(*b*) account for about one in four of all those in receipt of relief. If the unemployed are deducted, thus leaving only those who would be receiving relief in times when unemployment is not excessive, they account for about one in two. It is impossible to say what proportion of persons falling under these heads have found their way there owing to ill-luck such as accident. It is reasonable, however, to assume that the mental and physical infirmities of the large

majority of the cases have a basis in inheritance. That is certainly the case with regard to the mentally infirm, who form a very much higher percentage of those in receipt of relief than they do of the population as a whole.

It follows that inheritance plays a not unimportant part in the problem of pauperism. Deducting the unemployed, it may be suspected that something well over a half the remainder are in receipt of relief owing to misfortune, and that something under a half have been handicapped by mental and physical infirmity having a basis in inheritance. These conclusions are of the most tentative nature and no great weight can be attached to them. They receive some support from the pedigrees compiled by Mr. Lidbetter and others, which show that there are families among whom for generation after generation the proportion of paupers is large. These stocks show a high incidence of crime, alcoholism and mental defect, and it is likely that innate mental deficiency and emotional instability manifest themselves not only in crime and alcoholism as suggested above, but also in chronic recourse to Poor Law relief.

The conclusions to be drawn from the discussions in this chapter confirm those which were suggested by the facts discussed in the last chapter. Whether we consider racial groups large or small, or whether we consider the classes into which members of the

same racial group fall, we find that the differences between the average of one group compared with another are small. The differences are small relative to the vast differences which exist between members of the same community. Innate differences, therefore, are not distributed at random throughout the population. On the other hand, the distribution of innate qualities approximates much more closely to a random distribution than it does to a segregation of innate qualities according to occupational or social distinctions.

These conclusions throw further light upon the problem of the part played by inheritance in achievement. If we judge a man's achievement by the occupation he follows or the section of society to which he belongs, then achievement is determined far more by differences in social environment than by inherited differences. If a man is a scientific worker, say a biologist, it is probable that his intelligence is somewhat above the average for the population as a whole. There are barriers surrounding the entrance to the profession which keep up the standard. But it is unusual opportunity far more than unusual intelligence which has enabled him to become a scientific worker. Inheritance plays some part, but no large part, in determining what a man will achieve, as judged in this manner. If, however, we compare

the achievement of a worker in a branch of science, say biology, with the achievements of his fellow-workers in the same branch of science, then his performance relative to theirs is a fair measure of his endowment. The vast differences between the performances of different workers provide an indication of the fact that the innate differences between members of small elements of the community are far more striking than the average differences between different sections.

CHAPTER VIII

RACIAL CHANGES AND THEIR CAUSES

In the preceding chapters the part played by inheritance to-day has been discussed. But the part played by inheritance does not remain unchanged from generation to generation, because the inherited basis of any one generation is seldom if ever similar to that which preceded it or to that which follows it. Mutations can and do produce such changes. They are, however, rare and it is not to them that the changes referred to are, except in a very small and uncertain degree, to be attributed. The changes referred to come about because the genes present in any one generation are seldom present in the same proportion in the germinal constitution of the next generation owing to the fact that different stocks have different effective fertilities. To take a very simple example. There are genes controlling skin colour, and in any one generation of the world population the genes controlling one colour, say yellow, are present in a certain proportion to the total of such genes. If one racial group, say the yellow,

has a greater effective fertility than another, say the white, then in the next generation there will be a larger proportion of yellow to white genes, and racial change will have thus been brought about. Our object in this chapter is to discuss the extent and the causes of some of the more important of such changes as are in progress at the present day. Our method will be to inquire into the relative increase or decrease of groups the previous consideration of which has given reason to believe that they differ in respect of their innate endowments.

The following table gives an estimate of the population of the different continents in 1910 and again in 1920. The total estimated increase and the increase per cent. are shown.

World Population

	1910. Thousands.	1920. Thousands.	Increase. Thousands.	Per cent.
Europe .	447,480	452,102	4,622	1·0
America	180,397	207,909	27,512	15·2
Africa .	126,854	132,580	5,726	4·5
Asia .	858,497	990,809	132,312	15·4
Oceana .	6,866	8,096	1,230	18·0

While the continental divisions do not correspond at all accurately to racial divisions (there are, for instance, white men in every continent), the large majority of those com-

posing each great division of the human race are concentrated in one or perhaps two continents. The very different rates of increase of the inhabitants of each continent do therefore indicate that the proportion which the great divisions of the human race bear to the world population are changing. The white men, for instance, are not maintaining their position.

Let us now consider one continent. The following table shows what proportion of the total population of Europe (taking it at 100) each country contributed in 1880 and 1910 respectively.

	1880.	1910.
England and Wales	7·77	8·06
Scotland	1·12	1·06
Ireland	1·55	0·98
France	11·20	8·76
Germany	13·54	14·52
Austria	6·63	6·38
Belgium	1·65	1·66
Hungary	4·71	4·67
Italy	8·52	7·75
Russia	25·82	29·13
All other countries	17·49	17·03

Some countries, such as Belgium and Hungary, have maintained their position; others have gained, Russia and Germany, for example; while others, again, of which France and Ireland are instances, have lost.

Keeping for future discussion the possible consequences of these facts, let us ask to what causes these varying rates of increase may be attributed. The problem is intricate and obscure, and it must suffice to point to two factors, each of which plays a part of some importance. If we take a map of the world and shade heavily those countries in which increase is most rapid, and lightly those where it is slow, it becomes at once apparent that the former countries fall into two classes. There are the countries long occupied and settled, but behindhand in economic development, and there are the recently settled and in consequence half-empty countries. Of the former Russia and Japan, of the latter America and Australia are examples. Improved methods of production originating in one area make possible, and in fact call forth, an increase of population in that area. Later the new methods are applied in other countries and the growth of population there is stimulated, whereas in the countries where the new methods were first elaborated population may be only increasing slowly. During the earlier part of the last century new industrial methods were put into practice in England and the population increased with unparalleled rapidity. Towards the end of the century Russia began to use these same methods and her population began to increase with rapidity, by which time the rate of increase in

England had slowed down. The explanation of the higher rate of increase in the recently settled countries is more obvious. There is abundance of fertile and unoccupied land.

These two factors are by no means the only factors, but they are among the more important. They do not account for such interesting and important facts as the failure of France to keep her position. An inquiry, however, into the other factors which are at work, besides leading us somewhat beyond the scope of our present inquiry, would be impossible for lack of space, and therefore it must be enough to indicate the more important causes which are at work. Regarding those mentioned above, it is of interest, in view of the discussion in the next chapter, to note that it is for all practical purposes "inevitable" that they should from time to time operate, and that in consequence it is hardly within the range of practical politics to attempt to counteract them, even if it was thought desirable to do so.

More detailed information is available regarding the racial changes which take place within groups. They are of greater interest because, in the first place, owing to the diversity of endowment of the members of a group, vast changes may ensue as the result of differential fertility, and in the second place the control of racial change may be made the object of social policy. Space being

limited, the position in this country will naturally occupy most of our attention. The Report of the 1911 Census provides very important information bearing upon this subject. The data have been analysed by Dr. T. H. C. Stevenson, and use is made of his paper in what follows. The population can be classed in descending order of social scale, and in the following table Class 1 contains the upper and middle classes, Class 5 unskilled labourers, and the intervening classes those in intermediate social positions. Classes 6, 7 and 8 are special classes consisting of textile workers, miners and agricultural workers respectively. Since we have information regarding the birth-rate and the child mortality of these various classes, it is possible to calculate not only the total but also the "effective" fertility, or the number of children surviving per 100 families in each class. This crude rate can then be standardised to allow for the later marriage of certain groups, and we thus arrive at the following tables.

TOTAL FERTILITY

(Children born per 100 families)

	Classes.							
	1.	2.	3.	4.	5.	6.	7.	8.
Crude rates . .	168	205	232	237	268	191	282	284
Standardised rates	187	211	231	236	253	197	274	278

EFFECTIVE FERTILITY
(Children surviving per 100 families)

	Classes.							
	1.	2.	3.	4.	5.	6.	7.	8.
Crude rates . .	190	241	279	287	337	238	358	327
Standardised rates	213	248	278	285	317	247	348	320

These figures represent the fertility of marriage in the different classes and not the fertility of the classes. Since the members of Class 1 marry less and later than the members of the other classes, these figures do not fully represent the differences in the contributions which the classes make to future generations. The class which marries most is that consisting of workpeople in steady employment. The highest and the lowest class marry least. Bearing in mind that this fact must be taken into consideration if we wish to compare the fertility of the classes as wholes, it is evident that the effective fertility of marriage increases with descent in the social scale.

Class 1 is of less homogeneous composition than the other classes, and it is of interest to compare the figures for some of the elements of which it is composed, selecting those which presumably have the highest innate intelligence.

Effective Fertility
(Children surviving)

Husband's Occupation.	Average Actual Family.	Standardised Family.	Ratios per cent. of England and Wales.		Standardised Child Mortality.
			Actual.	Standard.	
All Class 1 Occupations	1.68	1.87	72	80	123
Army Officers	1.41	1.52	61	66	85
Naval Officers	1.27	1.45	55	62	92
Clergymen (C. of E.)	1.72	1.89	74	81	68
Other Ministers	1.71	1.98	73	85	120
Barristers	1.55	1.66	67	71	69
Solicitors	1.62	1.75	70	75	70
Physicians	1.57	1.67	67	72	81
Teachers	1.50	1.77	64	76	105
Authors, Journalists, etc.	1.58	1.68	68	72	108
Consulting Engineers	1.57	1.69	67	73	92
Architects	1.52	1.73	65	74	86
Artists	1.55	1.63	67	70	118
Commercial Travellers	1.77	1.89	76	81	124
Accountants	1.60	1.75	69	75	95
Auctioneers	1.76	1.82	76	78	109
Bank Clerks	1.29	1.63	55	70	82
Civil Service Clerks	1.64	1.84	70	79	108
Insurance Clerks	1.76	1.91	76	82	131
Commercial Clerks	1.56	1.86	67	80	130
Private Means	1.44	1.51	62	65	93

Evidence is available to show that in other countries in a somewhat similar condition of social and industrial development the social classes also make markedly different contributions to future generations. The phenomenon is widespread at the present day. Has this always been so? The evidence, such as it is, derived from a study of social conditions

in Europe in the eighteenth century, suggests that, if there was any difference between the fertility of one class and another, it was the "upper" and not as now the "lower" classes which contributed most to subsequent generations. This conclusion finds support in the figures given by Dr. Stevenson as the result of an extension backwards of his inquiry. The following are some of his figures, which show the effective fertility of each class for marriages contracted at different periods expressed as a percentage of that of all classes at the same period.

STANDARDISED EFFECTIVE FERTILITY OF MARRIAGES

(Per cent. of the corresponding rates for occupied persons for all classes jointly)

Date of Marriage.	Duration of Marriage in years.	Social Class.							
		1.	2.	3.	4.	5.	6.	7.	8.
1906–11	0–5	83	93	99	102	111	84	116	116
1871–81	30–40	86	96	100	101	105	89	110	116
1851–61	50–60	91	102	98	98	99	91	97	111

The further we go back the more alike are the contributions made by each class to the next generation. The facts "seem to suggest," says Dr. Stevenson, "that if the comparison could have been carried twenty years further back, a period of substantial equality

between all classes might have been met with." The phenomenon is therefore of modern origin. What is happening in this country to-day? Are the contributions of the classes becoming less or more alike? That is a question to which a definite answer is very much to be desired. Some figures given by Mr. de Jastrebski are of interest and, while their interpretation is for certain reasons doubtful, suggest that the difference between the classes may be on the decline. He divided the London boroughs into two groups—one the western group, containing a larger proportion of the "upper" classes than the other, the eastern group. He has the following table:

	1911.	1921.
East group—crude birth-rate .	31·1	26·9
West " " " .	17·3	17·0
East group—effective birth-rate .	26·6	23·3
West " " " .	15·9	15·8

The crude and the effective birth-rates of the western group have remained much the same, whereas those of the eastern group have declined during these ten years.

Why do the classes differ in respect of their effective fertilities? There are two factors at work—differential birth-rate and the differential mortality. To take the latter first. In general the higher the birth-rate the higher

the mortality, and therefore this factor so works that it tends to counteract the effect of the differential birth-rate. If children born in different social classes had the same chances of survival, the contributions made to future generations by the classes would be more different than they are. Looking into the matter more closely it is found, as the tables on page 171 show, that there are important differences between the occupational groups. Thus the miners have a higher birth-rate than the agricultural workers, but also a higher mortality rate, and thus there is little difference between the groups in respect of their effective fertilities. The textile workers have a relatively low birth-rate and a relatively high mortality rate, with the result that their effective fertility is low. It thus appears that while the infant mortality rate tends to vary inversely with the rate of wages, it is also subject to occupational influences having nothing directly to do with wages.

The problem of the cause of differential fertility is a more intricate matter. The immediate cause is not doubtful; the upper classes began to practise earlier, and still practise to a greater extent than the lower classes, family limitation. Family limitation includes both deliberate restriction of intercourse and the use of contraceptive methods. To understand the decline in the birth-rate there is no need for any other explanation,

such as a loss of fertility. The beginning of the decline corresponds with the beginning of propaganda in favour of family limitation; the decline is most marked among those classes which, owing to their better education, would first be affected by the propaganda, and now that the propaganda has been intensified and the lower classes are better educated, it is producing an increasing effect upon them.

The real problem is why the upper classes practise family limitation more than the lower classes; it is only partly answered by saying that the upper classes have easier access to and are better prepared to adopt this practice. Many other factors enter in, among which the following are the most important. (*a*) There is more opportunity for relaxation among the upper classes and therefore less inducement to marry young. Young people of the poorer classes find little comfort in their parents' home and few decent facilities in the way of lodgings. To be comfortable they must marry and have a home of their own. (*b*) Work-people often receive as high a wage at an early age as they will ever receive, whereas at a corresponding age in the professional classes young people may not have completed their education and the maximum income may not be attained until middle life. (*c*) Connected with the last factor is the free education of children in one class and the costly education of children in another class, which, taken in

conjunction with the factor that children over fourteen often contribute to the family income in the poorest class, and when older and married assist to support their parents, renders children an economic asset in one class and a burden in another where different conditions prevail. (*d*) On the whole the higher the status of women, the more is family limitation practised, as, for instance, in the upper class, where women are educated, and in the textile worker class, where women are frequently employed and therefore more independent. (*e*) Where there is a standard of living to be maintained, the greater is the inducement to limit the number of children for fear that the standard might be endangered. (*f*) The tendency is for the standard of living to be forced up in each class and in each grade of our Class 1 until, no matter how well off married people may be, they think that they cannot afford to have a large family. At a certain grade in the social scale, for instance, people think that they are entitled to a motor-car, although it may be of no use to them in their professional activities. The importance of this factor is usually much under-rated. Finally, one factor is often over-rated. It is true that small incomes and heavy taxation do make it difficult for some professional people to give their children that education which will enable them to enter professions of a grade similar to their own. Nevertheless, when all allowances are

made for taxation, the differences between the net incomes of those in Class 1 and those in the lower classes are so great that it is only when such luxuries as motor-cars are included among the things which the income must provide that it can be said that the income of persons in this class is insufficient to enable them to maintain large families.

From a consideration of the groups into which the population of the country as a whole falls we may now pass to a consideration of certain groups in the population which may very probably be distinguished from the rest of the population in respect of their innate qualities. The first group to which attention may be paid is that of the *Mentally Deficient* and of the *Insane*. Careful investigations into the family histories of mentally defective persons have shown that in as many as 80 per cent. of the cases a neuropathic ancestry can be traced, by which is meant that in these cases one or more of the relatives exhibit mental deficiency or some allied mental disorder. It is difficult to make these investigations exhaustive, and it is probable that in less than 20 per cent. of the cases the mentally deficient condition is wholly acquired and independent of inheritance. In these remaining cases the condition may have been induced by one or other of many factors, among which may be mentioned lesions of the brain induced by pressure during protracted labour or difficult delivery, lesions

produced by injury after birth, injury to the brain directly due to some form of poisoning, or indirectly to such common diseases as scarlet fever or whooping-cough, or to less common diseases such as encephalitis lethargica or sleepy sickness.

Mental deficiency is thus in the main an inherited and not an acquired condition. It may be conveniently thought of as that form of mental abnormality which is distinguished by imperfect development, whereas insanity is marked by the disorder of the mental faculties, though recent work tends to show that no sharp dividing line can be drawn between these conditions. The Royal Commission of 1904 distinguished three grades of mental deficiency: (1) The feeble-minded, the least afflicted class, were defined as persons in whose case there exists "mental defectiveness, not amounting to imbecility, yet so pronounced that they require care, supervision and control for their own protection and for the protection of others"; (2) the imbeciles, characterised by "mental defectiveness, not amounting to idiocy, yet so pronounced that they are incapable of managing themselves or their affairs," and (3) the idiots, characterised by such deficiency as to be unable to guard themselves against common physical dangers.

The Royal Commission calculated that there were on January 1, 1906, 138,529 mentally deficient persons in England and Wales. It has also been calculated that there were at

the same date 125,827 insane persons, and that out of every 10,000 of the population there were 2 idiots, 7 imbeciles, 29 feeble-minded and 36 insane, and that therefore one person in every 135 of the population was either mentally deficient or insane. These figures were little more than rough guesses owing to the absence of any accurate data. Accurate data are still lacking. Recent investigations show that the numbers falling in these various classes were certainly under-estimated. The Chief Medical Officer of the Board of Education in his report for 1923 estimates the percentage of mentally defective children of school age for England and Wales at ·86. Careful inquiries have been made in Birmingham, and it has been found that 1·1 per cent. of the school population is mentally defective. It is very unlikely that the incidence of mental deficiency is higher in Birmingham than in other large towns. The estimate of the Royal Commission was that ·7 per cent. of school children were mentally deficient. If it should turn out to be the case that the estimates of the Commission for all classes of defectives and insane were similarly under-estimated, then the proportion of such persons in the population would be nearer 1 in 100 than 1 in 148.

Little is known regarding the distribution of mental deficiency and insanity with regard to social class, profession and locality. There are indications that feeble-mindedness is not

distributed at random in the population. If we assume that feeble-mindedness is inherited as a simple recessive factor and that it is distributed at random, we should expect to find that only 5·5 per cent. of the parents of the feeble-minded were themselves feeble-minded. Actually we find that from 25 per cent. to 50 per cent. of the parents of the feeble-minded are themselves feeble-minded, and from this we are entitled to deduce that the defect is not distributed at random, but is concentrated in certain stocks. This is what we should expect to happen if assortative mating, to which further reference will be made later in this chapter, plays any part in the marriage of these persons. There is no evidence to show whether these stocks are concentrated in certain social classes or professions. There is some indication that idiots and imbeciles are relatively more numerous in rural than in urban districts, and that mentally deficient children, but not mentally deficient adults, are more numerous in towns.

The problem presented by the existence of these classes of persons is thus one of no small importance. Here, however, we are more especially interested in the question whether the proportion of the persons in the population is changing. No reliance can be placed on changes in the totals in institutions. Alterations in the extent of institutional accommodation available and the use made of it wholly obscure such changes as may be

taking place in the numbers of these persons. The fact that a considerable proportion of the insane, idiots and imbeciles are segregated for varying periods in institutions where they cannot reproduce their kind may result in these persons making a smaller average contribution to the next generation than is made by the rest of the population. Nothing definite, however, is known on this subject. The position of the feeble-minded is different. They are segregated to a less extent than the other classes of defectives. Some investigations seem to show that the stocks from which they come are among the most fertile in the population. As a set-off against this fertility must be placed the high rate of infant mortality where the mother is mentally deficient. In illustration of this the results of an investigation by Dr. Ettie Sayer may be quoted. Every seventh name in the register of special schools in London (schools, that is to say, for feeble-minded children) was taken and the family history investigated. A similar procedure was adopted in the case of an ordinary school. It was found that in the case of 100 normal families there was a total of 506 children born and 23 miscarriages, 387 children being then alive. In the 100 families from which the mentally defective children came there were 761 children born, 101 miscarriages and 467 children alive. That mentally deficient persons should be more fertile than the rest of the

population need not surprise us; they are by nature less susceptible to those various influences enumerated above which encourage the practice of family limitation.

Closely connected with the problem of the mentally deficient is that of the "*Backward*" or "*Retarded*" persons. These persons are those who, while superior to the mentally deficient, possess considerably less than the average amount of general intelligence. The Chief Medical Officer of the Board of Education in his report for 1922 estimates on the basis of inquiries made in London that there are some 600,000 "backward" children of school age in England and Wales and that "mental factors" which are "apparently inborn account for 60 per cent. of the cases." He goes on to say that "this group is unable to respond with proper benefit to our educational system and adds 50,000 recruits to our industrial army every year who are not only unprepared by mental retardation to meet effectually the demands of a full life, but who furnish society with the bulk of its inefficient adults—criminals, paupers, mendicants and unemployables. It is a serious national issue." It would be of the utmost interest and importance to know whether this large group contributes more than its proportionate share to the population of the future. While no figures are available, there is reason to think that these backward children become the more fertile parents of their generation.

Dr. Goring investigated the fertility of *Criminals* and found that they belong to the most prolific stocks in the community. The number of children in the families of habitual criminals is, however, much smaller than in the average family in the population as a whole. The reason for this appears to be not so much the segregation of criminals in prison as the numerous cases of desertion of criminals by their wives after a certain period of continually interrupted married life. Miss Elderton and Professor Karl Pearson investigated the problem of *Alcoholism* and found that alcoholic parents had more children than other parents of the same status, but that there was a higher child mortality, whence it resulted that the net family did not differ in size from that in non-alcoholic classes. There is no information which throws light on the problem whether *Pauperism* or *Unemployment* are connected with fertility greater or less than the average.

There is another method whereby this problem of the nature and extent of racial change may be attacked. Hitherto we have taken certain groups in the population and have asked whether they make greater or smaller contributions to future generations than the remainder of the population. It is also possible to consider certain agencies known to be in operation and to ask whether they bear more heavily upon some types than upon others. In other words, we can examine

these agencies and inquire whether they are selective.

It may be noticed in passing that *Pre-natal Mortality*, as a consequence of which many fewer children are born alive than would otherwise be the case, is far more prevalent than is generally recognised. There is some reason to think that the deaths which occur *in utero* are on the whole those of the physically better developed children. "In many cases," says Dr. Parkes, "the greater size and consequent greater requirements of a vigorous healthy fœtus may be a positive disadvantage to it, especially at birth. A very young mother or a very old mother or a woman with a contracted pelvis, for instance, will bear an undersized fœtus with far greater ease than a large one." It follows, therefore, that the improvements in medical and surgical skill which tend to reduce pre-natal mortality probably act so as to improve rather than to impair the germinal qualities of the race.

The extent of *Infant Mortality* is far more widely recognised. The infant mortality rate is measured by ascertaining the number of children who die under one year of age out of every thousand born. This rate has decreased rapidly in England and Wales in recent years. During the period 1891 to 1900 the average rate was 153; in the first four quinquennia of the present century the rates were 138, 117, 110 and 90. The rate varies as between one social class in the population and another.

The following figures are derived from the 1911 Census and show the percentage deviation of the fertility rates and of the infant mortality rates from the corresponding rates for England and Wales for the same eight classes into which the population was divided earlier in this chapter.

Class.	Description.	Percentage Deviation of Fertility Rates.	Percentage Deviation of Infant Mortality Rates.
1	Upper and Middle	—27	—39
2	Intermediate	—19	—15
3	Skilled workmen	— 6	—10
4	Intermediate	— 2	— 3
5	Unskilled workmen	31	22
6	Textile workers	—23	19
7	Miners	42	28
8	Agricultural workers	— 1	—22

This table illustrates the point made above, that while low fertility on the whole goes with low infant mortality, there are anomalies, as, for instance, in the position of textile workers. It is, however, the possible selective effect of infant mortality which concerns us here. If infant mortality is selective, the intensity of selection in whatever direction it may work has greatly diminished in recent years, and furthermore the intensity of such selection as there may be varies markedly from class to class.

It has been supposed that children who die at an early age are innately less strong than

those who survive, and that infant mortality is therefore a selective process—selecting the strongest for survival. This supposition invites a consideration of the nature of the process and a statistical investigation into its results. "Strong" and "weak" are vague terms. Most children who die under one year of age die from the attacks of certain diseases which are very prevalent in childhood. The survivors are those who are not so susceptible to these diseases. It is not known how far, if at all, lack of susceptibility to these diseases is correlated with lack of susceptibility to the diseases of adult life, and how far, therefore, "weak" children grow up into "weak" adults.

Support for this supposition has been claimed as the result of investigations made by Dr. Snow. He tried to trace children at successive ages and found a negative correlation between death-rates at ages 0 to 1 and ages 1 to 5. In other words, a group of children experiencing a high death-rate in the first year of life experiences a low death-rate in the next four years of life. This is explained by supposing that if in any such group the weaklings die in infancy, the death-rate is relatively low among the survivors at more advanced ages. Other investigations have failed to substantiate this correlation, and thus this method of attack cannot be said to have yielded definite results up to the present. It is perhaps worthy of note that those districts in England which

experience a high infant mortality rate also experience a high mortality for the first twenty years of life. While this evidence raises doubts about the truth of the supposition in question, it is not conclusive, because it is based upon the experience of communities and not of individuals at successive ages.

The work of Professor Holmes and his pupils is of interest in this connection. They have found that, as infant mortality decreases, so does the proportion of males surviving become smaller. They interpret these facts as follows. The male sex is the weaker sex. That in a sense is without doubt true; women live, for example, longer than men on the average. Where, they go on to say, conditions are bad and disease is rampant, this innate difference between the sexes is swamped and the infant mortality is approximately the same for both sexes. When conditions improve, the deaths which occur depend to a relatively greater extent than before upon innate constitutional differences, and therefore males perish in relatively greater numbers. If this is the true explanation, then the more infant mortality is reduced, the more selective does it become. This conclusion is precisely the opposite to that mentioned above, and until further investigations have been made the problem of the effect produced by infant mortality must be regarded as uncertain.

As we have seen, susceptibility to *Disease*

is no doubt to some extent inherited, though how far specific tendencies to contract different diseases are inherited is not clear. Everyone is not equally exposed to the risk of disease, but the germs of the more common diseases are so widespread that the inequality of the risk of contracting them cannot be large. This being so, it follows that disease is a factor of selection of the very first importance—selecting those who are innately the more susceptible. But it must be remembered that only those diseases are selective which, like whooping cough, attack the young; diseases like cancer, which for the most part attack those whose reproductive period is over, have no such effect.

Disease is always with us. From time to time the outbreak of *War* creates conditions which are far more favourable to the spread of disease than conditions which normally obtain in times of peace. The increase of mortality from disease among both combatants and non-combatants during war has usually been of far greater importance than the loss of life in battle. The chief effect of war is, therefore, to magnify the selective effect of disease. Of less effect but of no small importance is the loss of births due to the absence of combatants from home. Thirdly, there are the deaths in battle. The two latter results of war must have the same selective effect. The combatants as a whole have fewer children than they would otherwise have had; those among them who

are killed can contribute no more to future generations.

The direct selective effect of war depends upon the degree to which the combatants differ from the non-combatants. For the last hundred years wars in Europe have been fought on the basis of conscription. All men below a certain age are liable to serve, but only those who reach a certain standard of physical and mental fitness are taken. Selection is more rigorous on account of physique than on account of mentality; the mentally deficient, however, are rejected. It thus follows that those who are exposed to risk of death in battle are men who have not yet married or who have not completed their families, and who are mentally and physically fitter than the average. The direct effect of war is thus to bring about a loss of births in the families of the fitter men and to kill off a certain proportion of them. It must tend to lower the average mentality and physique of the population.

Many attempts have been made to measure statistically the effects of war, and in particular that of the prolonged wars which followed the French Revolution upon the population of France. Perhaps the most thorough and trustworthy investigation is that of Tschuriloff, who found, for instance, that between 1816-17 and 1826-27 the proportion of exemptions in the French army on account of infirmities rose from 26 per

cent. to 38 per cent. Further investigations, however, are required. Some work of Professor Gini is a warning that we should hesitate to accept the sweeping generalisations sometimes made as to the effect of war which may not be well founded. He inquired into the effect of the last war upon the population of Italy. He admits the adverse effect of the war upon physique, but has produced evidence to show that it is doubtful if persons, civil and military, deceased during the war would have achieved more than their contemporaries whom the war has spared. In particular he considered the Italian schoolmasters killed during the war, and came to the conclusion that they were not of a social value superior to that of their surviving colleagues. It may also be noted that he examined the effect of conscription in Italy before the war, and did not find that it had the results often attributed to it. It has frequently been supposed that conscription, by delaying the marriages of the fitter among the young men, reduces the contributions which they make to posterity. He found that these men on return to civil life marry more readily, and the enforced postponement of marriage is thus counteracted.

There can be little doubt that the direct effect of war is unfavourable, especially to physique, though it should not be forgotten that statistical proof is deficient at present. When the indirect effect of war is taken into

account in producing excessive mortality from disease, the net effect may be somewhat different. Two hundred years ago the mortality from disease among the civilian population during war was sometimes so heavy that the elimination of the less strong among them may have more than counteracted the mortality of the stronger on the field of battle. But we are here in a region of uncertainty and it is not profitable to pursue the matter any further. Enough has been said to show that care should be exercised before accepting the hurried generalisations about the effect of war which are not infrequently put forward. It is not necessary to say that even if war could be shown to be biologically favourable there is the strongest possible case against war on the grounds of its social results. Racial results alone are considered here.

That *Religion* is a factor of some importance in this connection may be gathered from the following table:

CHILDREN PER MARRIAGE IN PRUSSIA, 1875–90, ACCORDING TO THE RELIGION OF THE CONTRACTING PARTIES.

Creed of Father.	Creed of Mother.		
	Evangelical.	Catholic.	Jewish.
Evangelical	4·35	3·30	1·78
Catholic.	3·34	5·24	1·66
Jewish.	1·58	1·38	4·21

Those who profess different religions hold different views about the propriety of family limitation, and to this fact may be to some extent attributed the differences in the average size of the family. The greatest caution, however, is required in interpreting these figures. Those professing different religions may be more or less segregated in different sections of the population, and the fertility of these sections may vary quite apart from religious differences. Thus it may be that in certain cases we should attribute to class and occupational differences what we are at first sight inclined to attribute to religious differences. There is no doubt, however, that within the same class or section of the population religious differences are often connected with differences in fertility. Thus among the English landed gentry the decline of the birth-rate has been far less marked among the Catholics than among the Protestant families.

The varying fertility of members of different religious bodies is clearly of importance when, as is the case in many European countries and in America, adherents of the different religions belong for the most part to distinct racial stocks. This is not the case to any large extent in this country, though among the Catholics are many persons of Irish descent. But even where the more obvious racial distinctions do not characterise adherents of different faiths, the existence of more subtle

distinctions may be suspected. It is likely, for instance, that converts to the Catholic faith are distinguished by their temperamental qualities from the average of the population, and differential fertility may in these cases still be of importance. The celibacy of the priesthood is also of racial importance, especially since the priesthood may attract from among the adherents of the religion persons of a distinct type.

The importance of *Industrialism* as a factor in racial change has already been indirectly dealt with. It is in the main to industrialism that the division of the population into the classes mentioned above is due, the effective fertilities of which are so markedly different. The difference between the birth-rate of miners and textile workers, for instance, is connected with the lack of opportunity in the mining industry for women to work, whereas the opposite conditions prevail in the textile industry. The influence of industrialism upon modern life is profound, and any attempt to follow it would occupy more space than is here available. In one respect, however, it is of such importance that some reference to the matter is called for.

With industrialisation goes *Urbanisation.* In 1851 slightly more than 50 per cent. of the population of England and Wales lived under urban conditions; in 1911 the town dwellers formed 78 per cent. of the total

population. The town dwellers formed 28·6 per cent. of the population of the United States of America in 1880, and 51·4 per cent. in 1920. Is there any reason to think that town dwellers differ from country dwellers in respect of their innate qualities? It is very commonly supposed that it is the brighter, more intelligent and more ambitious of the young people in the country who migrate to the towns. Of this there seems to be no definite evidence. The American Census of 1910 throws some light upon this problem. It gives the proportion of city dwellers among the natives of different countries who were then living in America. Of the natives of Ireland, 84·7 per cent. were living in towns and 15·3 per cent. in the country; of the natives of Scandinavia, 52·9 per cent. were living in towns and 47·1 per cent. in the country. In their native lands Irish and Scandinavians are predominantly country dwellers, but when the choice is open to them the Irish flock to the towns. The explanation may lie in some innate temperamental difference between the Irish and the Scandinavians which renders urban conditions more attractive to the former than to the latter.

There is thus at least a possibility that city and country dwellers may differ in respect of their average endowments. It is therefore of interest to inquire what effect cities have upon those who live in them. In 1911 the legitimate birth-rate in terms of 1000 married

women, aged fifteen to forty-five, was for county boroughs 195, for London 199, for urban districts 192, and for rural districts 204. For the same period the expectation of life was greater for those living in rural than for those living in urban districts. Life tables for the three years 1910-12 giving the number of survivors out of 1000 at the age of twelve show that at all ages there were more males and females surviving in rural than in urban districts. Similar facts are disclosed by a study of figures from other countries, and there can be no doubt that town dwellers are not making a contribution to future generations proportionate to their numbers. If, therefore, the town dweller is on the average innately different from the country dweller, this particular type is not holding its own in the population.

There is some evidence tending to show that the selective process in towns differs from that in rural districts. The mortality from some diseases, measles, scarlet fever and diphtheria, for example, is higher in the town than in the country, whereas the mortality from whooping cough is greater in the country. Some data point to the relatively greater increase of dark types in towns, and it has been suggested that dark types may be less susceptible to diseases prevalent in towns. Investigations, however, have failed to establish any correlation between pigmentation and susceptibility to particular diseases.

Finally, reference may be made to certain agencies which, while they do not cause racial change, affect the distribution of racial characters in the population. *Assortative Mating* may be defined as a tendency for like to marry like. Investigations have shown that in respect of almost every trait examined assortative mating takes place. A man who exceeds the average height will usually marry a woman whose height is above the average. So too it has been shown that husband and wife resemble one another in respect of eye colour, hair colour, health, longevity, intelligence and mental deficiency as much as do first cousins on the average. Popular opinion seems inclined to precisely the opposite view, which shows how desirable it is that popular assumptions should be put to a rigorous statistical test. The importance of assortative mating lies in the fact that it tends to produce a population more heterogeneous in its inherited qualities than would otherwise be the case. Strains of high and low stature, of high and low intelligence tend to be sorted out and maintained. Mental defect, for example, tends to become concentrated in certain stocks. This heterogeneity of the population has both its advantages and its dangers. The concentration of undesirable characters such as mental deficiency in certain stocks makes it easier to deal with them than would be the case if they were distributed equally throughout the population. On the

other hand, if differential increase favours those stocks in which undesirable qualities are concentrated the results may be serious.

By *Preferential Mating* is meant that all those who want to marry do not have an equal chance of getting married. All women cannot marry because women outnumber men. Some men and women do not want to marry. If those who do not marry, whether from choice or necessity, differ from the rest of the population, preferential mating will cause racial change to take place, just as differential fertility brings racial change about. Very little is known with certainty about this important agency. An American investigator examined the records of a girls' school. Photographs of the girls were available, also the marks they obtained in their studies. The photographs were judged by impartial persons, and it was found that beauty as thus estimated considerably increased the chance of marriage. In this case what is no doubt the popular opinion was found to meet with statistical support. It also emerged that the more intelligent girls, as judged by their school performances, married most—a result that would perhaps not be so readily anticipated.

CHAPTER IX

RACIAL CHANGES AND THEIR CONSEQUENCES

The racial changes described in the preceding chapter are contemporary changes. But it is not the case that racial changes have only recently come into operation. Racial change has been more or less continuous since the very earliest days. In order to appreciate the importance of modern changes it is essential to have some understanding of the part that germinal change has played in the history of the race as a whole. Without some such background it is impossible to see modern changes in their true perspective.

A serious difficulty is met with at the outset of any inquiry into bygone days Statistical information illustrating the nature and extent of racial changes at the present day is scanty enough. Accurate information of this nature fails us entirely for periods a hundred years or more ago. It is necessary to rely upon such information as we have of social conditions and to deduce from them what racial changes must have been taking place. We know, for instance, that at one stage in the

history of the human race polygamy was very common among the chiefs and more prominent persons in the community. It may be deduced that those qualities which enabled men to rise and attain to these positions were transmitted to their numerous descendants. Polygamy must have functioned as a piece of social mechanism making for the increasing predominance of these characteristics in the population. Warfare has changed profoundly in character with the introduction of missile weapons and later of conscription, and deductions may be made as to the racial results that must have followed these changes. Among the sparse and scattered communities of early days disease could assume but little importance, and it may thus be deduced that the dense populations living under insanitary conditions characteristic of a later phase were subject to a new form of selection, and consequently to racial changes of a new character.

As a result of the pursuit of inquiries of this nature it is possible to arrive at certain conclusions. Lack of space does not permit us to review the evidence here. It is possible merely to state the broad conclusions which seem to follow from inquiries of this nature, and to take them as a foundation from which to set out upon the task to which most of the available space must be devoted, namely, the attempt to interpret the importance of contemporary changes.

Animals and plants in a state of nature

have no "history," and similarly our pre-human ancestors had no "history." But if we accept this common use of the word, we must remember that its application is deliberately restricted. What would have been the experiences of an observer who before the appearance of man had watched the events taking place on the surface of this planet? He would have noticed changes as the centuries passed by. He would have observed the appearance of a new type of animal bearing those characters which we associate with Mammals, and subsequently of many new types of Mammals, and at length of a primitive arboreal Primate, our own ancestor. If there was no "history" for our observer to watch, there were in any case changes. And there is no doubt as to the immediate cause of these changes. They were due to changes in the germinal constitutions of animals and plants. They were, in fact, racial changes.

Let our observer continue to watch and he will be a witness of that very strange tale of events the mere outline of which is known to us. The pre-human ancestor descends from the trees, begins to walk on two legs, loses his hairy covering and gradually assumes his present appearance. At the same time he begins to live in communities, to communicate by word of mouth, to practise various arts and crafts, and finally to build what we know as civilisation. As primitive times drew to a

close our imaginary observer would have found himself more and more busily occupied. Things began to happen more and more quickly. Arts were improved, new skill was acquired and customs changed—all in a few generations. Nowadays the outward appearance of things wears quite a new aspect after a few years. At some stage in the story we shall be permitted to speak of "history." To what were these later or "historical" changes due?

Among these later changes are many which, if due to racial change at all, are only very indirectly attributable to racial change. The historical events which have taken place in Europe during the last hundred years are primarily due to changes in the social environment. (During this later phase there have thus been two factors at work, racial changes and changes in the social environment.) Changes in the social environment begin to assume importance as the historical period approaches. The problem is to assess the relative importance of these two factors in the later phase.

In approaching this subject three points should be borne in mind. In the first place, physical characteristics such as hair colour, eye colour, stature and resistance to disease are the products of heredity and environment only, and are not less so now than in the days of our pre-human ancestor. The rise of the social environment to be a factor of impor-

tance in other directions has made no essential difference to the position so far as physical characters are concerned. Physical change now, as formerly, is to be attributed to genetic or racial change. Secondly, so far as the physical basis of mental characters is concerned, the position is precisely the same as that just outlined for physical characters. The addition and subtraction of mental acquirements are all that can directly result from changes in the social environment. Thirdly, the social environment does not work independently of the innate mental basis. What can be acquired depends upon the innate capacity for acquirements.

Looking at the problem as a whole, it follows at once that, so far as history takes physical changes into account, the origin of such changes is at all periods to be sought in the germinal constitution. No confusion should be caused by the fact that changes in the social environment alter the nature and extent of the selection of physical characters. If urban life does tend to eliminate the fair-haired, it is a process of precisely the kind that occurs when the more slowly moving members of a species of antelope are caught and eliminated by some species of carnivore. Physical changes in the past were the results of racial changes. Racial changes which occur to-day in the genetic factors underlying physical characters become immediately apparent in the physical constitution of the

race, and are the sole causes of changes in the physical constitution.

With respect to physical characters, the position is in general clear, though the detailed history of the changes is shrouded in obscurity. It is otherwise with regard to mental characters. There was a time when racial changes accounted for all changes in mental characters. And these changes were of the utmost importance. Our ancestors slowly came into possession of those mental faculties which now distinguish man from all other animals. The evidence goes to show that some time before the beginnings of civilisation our ancestors had attained to the full possession of those mental faculties now characteristic of civilised races. The evidence is partly based upon the fact that the size of the brain has not increased since the beginnings of civilisation. This is in itself not very conclusive, because mental capacity may be as much a function of the minute structure as of the gross size of the brain. It is also based upon the fact that there is no evidence of any selective mechanism at work in civilised times whereby mental faculties could have been enhanced.

If it is true, as is now widely held, that racial changes in mental characters have been inconsiderable since the beginnings of civilisation, it follows that we must look to changes in the social environment for the immediate explanation of historical events. Once a certain level of intelligence had been reached,

men were stimulated by contact with the environment to make inventions which they were able to preserve in such fashion that subsequent generations began where they had left off. History in the ordinary sense of the word took shape. The environment is very diverse. Among its more important features are its richness or poverty relative to the stage of culture attained and the opportunity given for contact with other cultures. An environment is rich to a people beginning to adopt agriculture when it contains a number of cereals and other plants easily capable of cultivation and yielding a big return. Similarly, an environment is rich to a people taking up the domestication of animals when several species are present both capable of and worth being domesticated. A survey of the course taken by civilisation shows that these two factors have played no small part. Civilisations founded upon agriculture have arisen in "rich" environments, and the most advanced have been those which have been favoured with opportunities for contact with other civilisations, whereby knowledge of new arts may be derived and a stimulus given through emulation and rivalry. It is possible to advance on these lines a long way towards an explanation of the course which civilisation has taken. To take only one example, the American Indians were a long way behind European peoples when discovered by Columbus. From very early days their develop-

ment had proceeded for all practical purposes independently of that of Europeans. They were behind because their environment was not so "rich" as that of Europe to men in an early stage of agricultural economy. Animals fit for domestication were also scarce. Europeans were more favoured, and advancing quickly through the agricultural stage passed on to a civilisation such as we now know, and "discovered" the Indians still in a stage corresponding to that through which Europeans had passed some few thousands of years before.

It does not follow, however, that genetic changes have played an altogether subordinate part in the history of civilisation. In one sense it is genetic change which alone has made civilisation possible. A certain average level of mental capacity must be reached before those acquirements which mark civilisation can be made. It is possible that the failure of the great negroid group of the human race to reach this level accounts in large measure for their failure to build up a civilisation. It is true that the environment of the negroes has not been in all respects as favourable as that of some of the other great divisions of the race. But it seems likely that not only in their case, but also in the case of some other smaller groups, lack of achievement is to be traced in the main to the absence of such germinal changes as might have brought their mental development to the level of European races. In this very

important sense civilisation is founded upon germinal changes.

These germinal changes, however, are antecedent to civilisation. Have germinal changes played any part in shaping the peculiar course which civilisation has taken? While it is probable that germinal changes have not been large, it is possible that they may have played no insignificant part. There is, as we have seen, reason to think that the great groups of the human race are distinguished by innate temperamental differences, and that such differences may in a lesser degree mark the smaller groups. However they arose, they may well have left their mark upon the whole course of the history of the groups. The explanation of the different course which history has taken in Europe as compared with Asia may depend to no small extent upon temperamental differences. It has been pointed out that these differences once established tend to increase. A group inclined to be submissive will encourage an authoritative form of government, and such a form of government will make life less easy for the independently minded and will so make innate submissiveness more prevalent. So too when searching for an explanation of the differences between smaller groups, between the French and the English, for instance, no little importance may be found to attach to relatively small temperamental differences.

The course of civilisation has not run

smoothly, and it has been suggested that the explanation of the ups and downs is to be sought in germinal changes—some favourable changes having preceded and made possible the upward movements and some unfavourable changes having preceded the downward movements. No satisfactory evidence has been produced to show that conditions which might be supposed to bring favourable germinal change about do, in fact, precede the rise of civilisations. Differential fertility, on the other hand, does not infrequently accompany the decline of civilisation. But differential fertility appears as a rule to set in after the decline has begun and to be one of the signs of decay. Supposing such differential fertility to be unfavourable, as may very likely be the case, it would hasten but not initiate the process of decline. That differential fertility is not a cause of decay is probable on other grounds. The ups and downs are in all probability different aspects of the same phenomenon, and the kind of explanation which accounts for the one probably also accounts for the other. Since there is no evidence that the ups are initiated by genetic change it is improbable that the downs have any such origin. That both rise and fall may occur independently of any genetic change seems to follow from the fact, as pointed out by Mr. Huntington, that in Iceland, where there has been no infusion of foreign blood and no sign of racial

change through differential fertility or any other cause, there have been periods of depression and periods of achievement—ups and downs, in fact.

As our observer, therefore, watched the historical events of the last ten thousand years, it would soon have become apparent to him that changes in the social environment were assuming greater and greater importance. Among civilised peoples the happenings which attract immediate attention are not the direct consequences of germinal changes. He would realise that the failure of some groups to achieve civilisation was due to the inferiority of their innate equipment, and he might be tempted to attribute the lapses into barbarism of civilised peoples to genetic deterioration. But he would probably find reason to revise this latter opinion in so far as the beginning of the decline is concerned. Still further reflection might lead him to suspect that the general tenor of a civilisation and achievements of one group compared with those of another were not altogether explicable in the light of explanations based upon differences in their surroundings. And in the end it is rather the colour and timbre of a civilisation which is important than the achievements which first attract attention. And it is perhaps to relatively small temperamental and other mental differences, the origin of which is obscure, that the tenor of a civilisation is in no small degree to be attributed.

The foregoing discussion, wholly inadequate as it is in view of the complexity and importance of the problems involved, has been undertaken in order that the racial changes in progress in our own times may be seen in their proper perspective. From this discussion it has emerged that physical characters are controlled now as in the past directly by the factors in the germinal constitution which underly them. Changes that we may observe, such as an increasing percentage of dark-skinned persons, are to be attributed to germinal changes, and similarly we may assume that germinal changes in the genes controlling physical characters will be at once made visible in the physical constitution of the population. With regard to mental characters the position is not so simple. If by mental characters we mean the whole make-up of the mind, then those differences which distinguish one generation from another, ourselves from the Elizabethans, for example, or even one people from another, may be very largely due to differences in the mental acquirements. Similarly, genetic differences in the factors underlying mental qualities may not become directly apparent; a decrease in average intelligence might be obscured by the continuation of the more or less mechanical accumulation of knowledge, giving rise to the appearance of progress and even of growing intelligence.

How then are we to interpret the signs of

the times? What on the whole is the direction and importance of the changes now in progress in the genetic factors underlying the physical characters? These genetic changes come about not only on account of selection, that is, by the elimination of persons carrying certain genes before they can reproduce, and on account of differential fertility, whereby persons with particular endowments have more or less than the average number of children, but also on account of mutation. There are not only, in other words, processes whereby existing genes are sifted out and either a better or a worse complement of genes is provided for the next generation, but also a process whereby the genes themselves are transformed. This transformation is rare, but there is reason to think that it becomes of importance in modern times, and attention may first be paid to it.

Such evidence as there is goes to show that mutations may occur with equal probability in any direction. It would thus appear at first sight that a mutation is as likely to be favourable as unfavourable. A little reflection, however, shows that this is not the case. Take a complicated organ such as the eye. It consists of many parts controlled by different genes. If the eye is to be a satisfactory organ, these parts must harmonise. Now, even supposing that each one of these genes may equally well mutate in any direction, and that therefore a mutation

is as likely to make a part larger as smaller, and thus is as likely to be favourable as unfavourable so far as the part is concerned, it is at the same time apparent that only a few of the possible mutations of any one part can be expected to harmonise with the other parts and so help to produce a better or more efficient organ of sight. On these grounds it is to be expected that mutations will be far more often unfavourable than favourable.

These facts are of no little importance in view of modern conditions. Only recently has any general desire been manifested that special provision should be made for the infirm and physically disabled. Only very recently have means been discovered of rendering any effective help. Thus in former times the infirm were at a disadvantage, and in consequence married less and had fewer children than other persons even when they survived to reproductive age. Nowadays, while advance has been made in the direction of assisting the less resistant to survive the attacks of parasitic diseases, greater progress has been made towards putting the less physically well endowed upon an equality with persons of normal endowment. The skill of the oculist places the short-sighted in as good a position as the normal person, and persons suffering from this inborn infirmity are on this account no more likely to die early and have no more difficulty in marrying and supporting children than normal people.

And the same may be said of those with bad teeth, bad hearing and malformations such as that which causes diabetes. In other words, selection on account of physical infirmities of many kinds has very largely ceased.

This cessation of selection does not mean that improvement has stopped. The selection formerly in progress did not necessarily bring about improvement. It may have resulted simply in keeping the physical constitution up to a certain level. It means that the machinery for correcting the tendency of mutation to produce unfavourable results more often than favourable results has been weakened. The machinery is certain to be still further weakened as our skill to compensate people for their physical disabilities increases. The result is not doubtful. Until very recently, for instance, mutations underlying the diabetic condition could not become more prevalent in the population because the sufferers as a whole had less chance of leaving descendants than other people. Such mutations will now be preserved within the genetic constitution of the race, because we have learnt how to compensate for this disability, and the disability will become more prevalent because unfavourable mutations are more common than favourable mutations in the organs concerned. Unless it is thought that physical disabilities are of no consequence if compensation for them can be found, if a set of false teeth is considered as satisfactory in

all respects as a man's own teeth, for example, it follows that the racial changes thus brought about must be among those that will engage our attention in the next chapter, when we consider in what respect modern racial change requires control.

So far as the campaign against disease is successful it results in placing those liable to contract the disease in as good a position as those who are so innately constituted as to be less subject to attack. The campaign takes the form both of attempting to render the results of an attack less harmful and of lessening the chances of attack. Greater success has attended efforts of the latter than of the former kind. Improved sanitation has greatly diminished the risk of contracting diseases such as typhus and typhoid. Disease, however, remains a very important factor in selection, and it is therefore a matter of much interest to know in what direction it works, and so far as the intensity of selection has been diminished what the results may be.

It seems probable that there is a general soundness of biological constitution which renders those who possess it less liable than others to contract any disease. This conclusion seems to be in accordance with common experience, and we may speak of strong and weak constitutions. It is sometimes suggested that certain diseases attack the apparently strong. This suggestion has been made in respect of cancer. Pearl's investigations show

that, so far as length of life is a measure of biological soundness, cancerous stocks are less and not more sound than the average. Disease, therefore, tends to select those with weaker constitutions. But how far is strength merely strength to resist disease? Suppose that exposure to infection was so much diminished by further improvements as to be negligible, would the "strong" still exhibit advantages over others? It is probable that "strength" does not merely indicate power of resistance to disease, but also general vigour, resistance to fatigue and capacity for hard and prolonged work. So far as this is the case, the lessening of the intensity of selection by disease, whether accomplished by removing the chances of infection or by rendering attacks less lethal, decreases the advantages that formerly accrued to soundness of constitution. It appears that the success of the campaign against disease involves to some extent a decrease in the average constitutional vigour of the race. It does not, of course, follow that the campaign is ill-advised and should be stopped. It merely suggests that some measures are desirable which, while preserving all the good results of the fight against disease, compensate for the undesirable results which at the present time appear also to be involved. What form these measures might take is a matter for consideration in the next chapter.

While we are here in the presence of what

is probably a very important selective factor, extremely little is known as to the results which it produces. We do not know how far those who are victims to a disease are merely of weaker constitutions than the average or how far they have a specific lack of resistance to this particular disease. Again, while it is certain that there is some selection, it is entirely uncertain how much selection there is. Take the case of tuberculosis. The death-rate from tuberculosis has declined. How far is this due to the elimination of stocks especially liable to contract tuberculosis, and how far to betterment of conditions or perhaps to the vaccinal influence of minute infections? With the decline in the death-rate has gone improvement of conditions. Is the latter the cause of the former? The fact that there is a very small degree of association between husband and wife in respect of tuberculosis has been interpreted as showing that heredity and not infection plays a predominant part. But it is claimed, on the other hand, that infection usually takes place at or before adolescence, and that it may not show itself for many years. If this is so, we should not expect to find any association even if infection does play a predominant part. It is necessary to keep an open mind as to the selective effects of disease. The indications are merely that it tends in some degree to eliminate the constitutionally weak, who are also generally the

physically weak. It may be added that there is no evidence to show that the constitutionally weak are the more mentally gifted, as has sometimes been suggested. The evidence from the measurements of scholars, for example, goes to show that the mentally gifted do not possess physical endowments below the average. There is no reason to think that by saving those whom disease would have taken we are saving persons who will contribute more than the average to the race on account of their mental endowments.

Among the many other factors at work there is space here only to consider the results of differential fertility. Differential fertility demands consideration because it is operating on so large a scale and with such rapidity. Unfortunately very little is known as to the effects which it is producing. One series of observations tends to show that on the whole the lower we go in the social scale the less physical fitness do we find. Since these "lower" classes contribute more than their share to future generations, differential fertility would seem to act unfavourably. On the other hand, two large groups among workpeople, the miners and the agricultural labourers, which appear to be the most physically fit, have the largest effective fertility. The position is too uncertain to permit the drawing of definite conclusions, but taking the population of this island as a whole, it is more likely than not that the

net result of differential fertility upon physique is unfavourable.

Reviewing the racial changes in physical characters known or suspected to be in progress at the present time, it is not possible to discover evidence that there are any important factors making for improvement. On the contrary, there are many factors at work the effects of which are probably unfavourable. One factor, the cessation of selection on account of physical infirmities, certainly works that way. And since the physical characters, and among them are not only height, pigmentation and similar features, but also health, energy, vitality and longevity, are to so large a degree determined by the underlying genetic factors, the seriousness of the probable trend of racial change to-day needs no further emphasis.

Turning now to the consideration of racial changes in mental characters now in progress, it may first be noticed that, as in the case of physical characters, no factors can be detected at work making for an increase in average intelligence. It may be that not for some centuries or even for some thousands of years has there been any mechanism at work tending towards an increase in the average intellect. But until recently mental deficiency was no small handicap, and in all probability the mentally deficient used not to contribute to succeeding generations in proportion to their numbers. Under modern conditions,

while the more extreme types, represented by the idiots and imbeciles, may not, owing to segregation, be contributing their quota to future generations, it is possible that the less afflicted and much more numerous section, the feeble-minded, may be contributing more than their quota. As in the case of physical characters, the cessation of selection, which is a consequence of our efforts to mitigate the lot of the less well endowed among us, may permit the survival of unfavourable mutations, and for the reasons given above unfavourable mutations are probably of more frequent occurrence than favourable mutations. It is therefore possible that while former conditions maintained the average at about the same level, modern conditions may be allowing deterioration to occur.

Differential fertility may be of greater importance in this connection. There is a sifting of the population in progress. The professions are recruited from among the more intelligent members of the population, and the members of the professions are relatively sterile. It is not likely that the mental differences between the sections of the population are large, but it is almost certain that they exist. But the differences between the contributions of the different sections are so large that differential fertility is in all probability of some considerable importance. It must have the effect of reducing the average level of innate intelligence in the population.

The various sections into which the population falls are also distinguished as regards their instinctive and temperamental characters. In the preceding chapter it has been suggested that under modern conditions certain characters, such as perseverance and ambition, are an aid to success and that others act as a hindrance. The former will in consequence tend to be less well represented in the next generation, while the latter will be more fully represented. That in general such changes are in progress cannot be doubted. Investigations into their precise nature have, however, hardly begun as yet.

It is very difficult to form any judgment as to the effects of racial changes in mental faculties. Racial changes in physical characters are immediately visible. Men become more or less constitutionally vigorous as the case may be. But what result is to be anticipated as the consequence of an advance or of a decline in the general level of intelligence? How will it affect the social environment through which it must manifest itself?

It seems clear that, the fuller and the more varied the content of civilisation, the greater is the value of high intelligence to the individual. High intelligence can now stand out more prominently than ever before. It has more and better tools at its command, and the acquirements that can be made have been multiplied many hundreds of times. It follows that high intelligence is of more

value in civilised than in primitive times. It may also be that the growing complexity of modern civilisation demands at least the maintenance of, if not an increase in, the present level of intelligence in order to sustain it. Racial changes tending to reduce the level of intelligence are thus very much to be deplored. It is not necessary to suppose that a decline in the intellectual level would show itself at once in the cessation or even in the slowing down of what is commonly known as progress. The accumulation even of scientific knowledge is in a sense mechanical and might continue long after a decline in intelligence had begun. We cannot expect to observe immediately intellectual deterioration as we do physical deterioration. A growing lack of control of the social machinery would probably be among the earlier symptoms.

It is possible to exaggerate the importance of intelligence and of changes in the intellectual level and to forget the importance of temperamental qualities and of changes in mental capacities other than the intellectual. As we have seen, it is likely that it is to temperamental rather than to intellectual differences that we should ascribe the differences between the performance and achievement of one nation compared with another, so far as innate differences come into the matter at all. Whereas on the whole there is some correlation between success and intelligence

in modern industrial countries, an association, that is to say, between success and a quality that is desirable and valuable, it is not equally certain that success is associated with temperamental qualities which taken together are more desirable than those which are characteristic of the less successful. The matter in any case requires more consideration than is usually given to it. The nature of the social system will determine the temperamental qualities necessary for success. Under almost any system some qualities such as energy, perseverance, resistance to fatigue, will be favoured which are on all hands regarded as desirable attributes. But whereas one system may tend to give the prizes to those who in addition to possessing these qualities are ambitious, domineering, acquisitive, of the brigand and tyrant types, another may make success easy for those of a less selfish type, whose instinct is rather to use opportunities for service than for acquisition. Some comfort may perhaps be derived from a review of modern conditions under which the successful do not make proportionate contributions to future generations. It is at least evident that our system is not so perfect that all the most socially desirable qualities are required of those to whom the system grants success.

Our knowledge of the racial changes in progress in this and other industrialised countries is too vague to enable us to draw

definite conclusions as to their consequences. There are many factors at work which appear to be causing racial change in an undesirable direction. It is impossible to be more definite. The ultimate effect of these changes upon our civilisation is a still more difficult and doubtful matter. There is, however, enough material both in the way of theoretical knowledge of heredity, of knowledge of the part played by heredity in human affairs, and of the changes which are taking place, to render some consideration of the control of racial change possible and desirable.

CHAPTER X

THE CONTROL OF RACIAL CHANGE

While men differ widely in their political views, all men have reforms in mind which they would like to see adopted. No one is satisfied with things as they are. We all wish to see measures taken whereby poverty may be reduced. If these proposals are examined it is found that they are based upon the use of one or more of the three following methods. It may be proposed to improve the physical environment, to better sanitary conditions, for example, and thus to reduce the incidence of disease and raise the standard of health and thus of productive capacity; it may be proposed to improve the social environment, to extend education, for instance, and so by making men more efficient and more productive to reduce poverty; or it may be proposed to improve the innate endowment of the race, to prevent, perhaps, the multiplication of idiots and imbeciles by segregating them, and so to contribute towards the solution of the poverty problem by reducing the number of those who cannot support

themselves. All such proposals aim at the building up of a better social system. Whereas proposals of the first two kinds aim at improving the methods of workmanship, proposals of the last kind aim at improving the material.

There should be no difficulty in gaining general assent to the proposition that if a more satisfactory state of society is to be built up, attention must be paid to the material as well as to the workmanship. But in making proposals for reform at the present day, undue attention is given to schemes based upon improvements in workmanship. Proposals aiming at the improvement of the material are not often made, and when brought forward receive little attention. Why should this be so?

Those who realise the importance of the material and who have very much at heart schemes for improving the innate endowment of the race seem frequently to believe that the neglect of their schemes is due to a general belief in equality. They appear to be under the impression that a belief in natural equality is common and that existing differences are almost wholly attributed to differences in opportunity. There are reasons for doubting whether this belief is as prevalent as is often supposed. It is not impossible that some of the more enthusiastic supporters of proposals to improve racial qualities have themselves only recently become aware of the importance

of innate differences and are inclined to suppose that more people are living in the state of ignorance in which they themselves formerly dwelt than is, in fact, the case.

However this may be, it is not the case, as is often also supposed, that belief in democracy is bound up with belief in natural equality. The famous declaration of the French Constituent Assembly did not state that "all men are free and equal," but that "all men are free and equal in respect of their rights." It is not true that theorists of "advanced" views have held any "dogma of natural equality." Robert Owen, for instance, "frequently insists," says Mr. Cole, his latest biographer, "on the importance of 'nature' as well as of 'nurture,' and does not aim, as some have supposed, at exalting the one at the expense of the other. 'Man is born,' he wrote in 1817, 'with combined propensities and qualities, differing in degree of power and of combination, sufficient to create through life individuality and distinctness of person and character.'"

There is perhaps some truth in the explanation of the neglect of proposals to improve the quality of the race as due to a dislike of schemes which seem to interfere with the most intimate and private human relationships, and which in general seem to treat men as though they were a breed of farm animals. Fortunately, however, common sense is sufficiently widespread to prevent objections

founded on such notions obtaining any great hold. A very little consideration shows that almost every scheme of reform affects directly or indirectly intimate human relationships. Changes in the income tax have a bearing upon the number of children which married people can afford to bring up; the segregation of criminals and lunatics does prevent them from propagating their kind even when it is undertaken in order to ensure their own safety or the safety of society. It is impossible to bring about environmental reforms without influencing indirectly intimate human relationships. It is, therefore, either ignorance of this fact or hypocrisy to object in general to proposals designed directly to influence these relationships on the grounds that such interference is meddling with intimate matters, and at the same time to support other schemes which indirectly bring about similar results. The objections based on the treatment of men as if they were beasts in a stockyard are apt to turn against those who put them forward. Men are and will remain animals on certain sides of their nature, and it is as necessary to bear this in mind in matters of reproduction as in matters of health. Those who wish to improve the feeding of children and to give them more exercise and open air are treating them every wit as much as animals in a stockyard as are those who would like to improve their natural endowments. The stock-keeper does not limit his efforts to securing a good ancestry; he

attempts also to secure the best environment. Why should those who wish to copy the efforts of the stock-keeper in one direction find that his methods in another direction are inappropriate and inadmissible?

There are two main reasons why schemes for racial improvement do not as yet meet with much support. In the first place, while for a long time the fact that like does in the long run produce like has received general recognition, it is only in very recent years that the mechanism of heredity has come to be understood. It is not enough that there shall be general recognition of the existence of natural inequalities; it is necessary that there should also be some general understanding how these qualities are inherited. Until a few years ago no kind of explanation was forthcoming of such common facts as "reversion," which seemed to fall outside any rules, and so long as common occurrences were not understood it was not likely that men would be prepared to act on the vague impression that in the end like tended to produce like. It may also be recalled that less than sixty years ago biological authority was in support of the view that species were fixed, that evolution had not occurred. When it is realised that proposals for racial improvement are proposals to take our evolution into our own hands, it is evident that evolution must be widely accepted before such proposals can gain any general support. It may seem

that fifty years is enough to enable any well-authenticated view to gain acceptance. But it has to be remembered that evolution was not accepted even by specialists for some years, and in our own day the inability of biologists to find any completely satisfactory explanation as to how evolution has occurred has confused many laymen and led them to think that there is also some doubt whether it has happened.

There is thus required a much wider understanding of simple biological facts and of the broad conclusions which are drawn from the study of animals and plants and universally accepted by authorities before proposals for racial improvement can be expected to appeal to the average man in the same way as proposals for environmental improvement appeal to him. When once it is generally understood that evolution has come about by means of racial changes, and that not only does like produce like in the long run, but that the apparent anomalies and exceptions are all understood and are not in contradiction to this general principle, then the ground will be prepared for the acceptance of the idea that his own racial evolution is an object for which man can and should strive.

A wide diffusion of elementary biological knowledge is the first necessity, and if this knowledge was acquired by children as part of a general education it might also be made to serve as a foundation for healthy views of the problems of sex. It may be hoped that

men and women armed with such knowledge will develop a sense of responsibility regarding the qualities of their children as is now being developed regarding the number of their children. It is now possible to say what are the probabilities regarding the innate qualities of the children of any marriage, and where the chances are that the children will be handicapped by mental or physical deficiencies it is to be hoped that the sense of responsibility will be strong enough to prevent people having children. Impatience is sometimes expressed when stress is laid upon the growth of conscience in these matters. Are we to wait, it is asked, and advocate conscientiousness while the unconscientious, who on that score alone are likely to be among the less desirable of the population, continue to propagate their kind with no concern for the qualities of future generations? It must be remembered that in modern communities reforms are not imposed from above and that proposals for racial improvement will only be accepted when their desirability is more generally understood. The majority will not consider taking steps to coerce the recalcitrant and unconscientious minority until they are willing to impose voluntary restraint upon themselves. The development of a conscience sensitive in these directions is a necessity precedent to legislative action, and the stress laid upon the awakening of such a conscience is thus justified.

A conscience in these matters is, however, by itself merely a guide to individual action. It is not a sufficient basis upon which to construct a social policy. Suppose that we are interested in the physique of the nation, it is necessary to know how the different sections of the population compare with one another in respect of their innate physical endowments and of their effective fertilities. The second necessity is, in fact, a wide knowledge of all those problems which have been discussed in the foregoing chapters of this book. Without such knowledge no social policy can be framed. Now it has again and again become apparent, even in the elementary discussion which alone has been attempted in this book, that our knowledge of these subjects is very inadequate. It has been found again and again that it is possible only to give the most tentative answers to the most urgent and important questions. It is therefore worth while, before considering what policy can be suggested on the basis of our very deficient knowledge, to turn aside for a moment and ask how more accurate and extensive information may be accumulated which is so necessary if detailed proposals are to be made.

It is evident that what is required is a periodical census of the mental and physical qualities of the nation in the first place, and a numerical census showing, as the 1911 Census showed, only in more detail if possible, the

effective fertilities of different sections of the population in the second place. Such censuses can only be undertaken by the Government. Not only is the task too vast for a body of private investigators, but compulsory powers are required in order that the investigation should not be incomplete, as it would of necessity be if the returns were voluntary. Provided that good cause can be shown why the information should be collected, the objection that the obtaining it by compulsory powers is an infringement of liberty is not valid. Everyone who enjoys the vast benefits of life in a highly organised community may legitimately be called upon to render information whether about his income, his height or his health, provided that the collection of the information is made as little vexatious as possible, and that use is made of it to further the interests of the community.

It might appear at first sight that a very elaborate machinery is required if this information is to be collected. This is not altogether the case. It is possible to use certain social machinery now in operation in order to gather much of the data that is required. It is true that there are great objections to making the questions now asked in the decennial census more numerous and elaborate, but this difficulty should grow less as the population becomes better educated. The more extensive use of the census machinery would provide all the information required as

to relative effective fertilities. The system of compulsory medical examination of elementary school children might be used in order to collect information as to physique and the prevalence of infirmities. The examination is not at present carried out on a uniform system; different local authorities, in whose hands the supervision of the examination is placed, do not all collect the same particulars and do not adopt similar standards. But the system might be standardised and expanded so as to provide much valuable data regarding physique. The methods of measuring intelligence are still in their infancy, but if, when they have been further elaborated, similar methods were employed by all local authorities, very valuable information would be available. Even as things are it should be possible to obtain accurate information as to the prevalence and distribution of mental deficiency; the administration of the Mental Deficiency Act is, however, notoriously imperfect. Owing to the various standards used and the varying degrees of energy exhibited in carrying out the provisions of the Act in different localities, no conclusions can be drawn either as to the increase or decrease of mental deficiency or as to its distribution among the various social classes or occupations.

It might be desirable that ultimately a special Government department should be set up having as its function the collection of data throwing light upon the germinal con-

stitution of the race and the changes which are taking place in it. Sweden was the first country to recognise officially the national importance of racial qualities. In 1922 the Swedish State Institute of Race Biology was founded at Upsala. It is under the control of a council of six members nominated by the Crown. The Institute is primarily concerned with research. It is hoped that as the facts become more clear, appropriate steps will be taken by the various Government departments concerned, both by executive actions and by the formulation of bills, to deal with the problems disclosed. It is not necessary to discuss whether similar machinery is desirable in this country. The important point is that, whatever machinery is used, the Government must collect the information. This will not happen until there is a widespread recognition of the importance of the matter and an informed demand that adequate staff and means be provided. As in other spheres, the Government cannot go far ahead of public opinion.

The Government machinery might also be used to collect information to throw light upon special racial problems, just as it is now used, as we have seen, to throw light upon such social problems as unemployment. Analysis of the data might also be undertaken by Government officials from time to time, but it is of no small importance that the data should be available for analysis by those

who are not Government servants, and are therefore not under any restriction as to the problems which may be illuminated and are not subject to any official pressure as to the conclusions to be drawn.

Many thousands of years ago man began to attempt to control his surroundings and so far as his powers allowed him to shape his own destiny. It is evident that if he is to make full use of his powers he must not confine himself to control of the physical and social environment; he must take upon himself the control of racial change. The problem facing us is therefore as follows. In the light of present knowledge of the importance of racial qualities to individuals and to civilisation and of the changes which are now taking place in them, what policy should be adopted?

Up to the present we have been concerned with the science of eugenics. We are now asking how this knowledge should be applied. It is clear that when making proposals to apply such knowledge we must have standards of value in mind. We must be able to agree that one quality is "better" than another, and that one kind of racial change is more desirable than another. Within the field of the science of eugenics it is at least theoretically possible, when the facts have been sufficiently investigated and adequate analysis applied to them, to obtain universal agreement. General agreement might, for example, be obtained to the proposition that acquisi-

tiveness was decreasing. There would clearly be wide differences of opinion as to whether this was desirable or undesirable. It so happens that in the discussion which follows these difficulties do not arise in a serious form. We shall assume that a decline in physique or a decline in intelligence is undesirable. Our knowledge of such changes in particular physical and mental characters as may be in progress is so slight that the more difficult problems do not arise.

It would appear that steps might be taken to control racial change in two directions. First, measures might be adopted to compensate for the cessation of selection. The cessation of selection has resulted not only in the survival of persons inheriting mental and physical deficiencies who would formerly have perished without leaving offspring, or at least who would not have had as many children as others, but also in the survival of those exhibiting unfavourable mutations. Those persons who suffer from grave mental and physical defects are a burden both to themselves and to others. The mentally deficient and the blind cannot live full normal lives. They have not within them the capacities for a full and happy existence. If we put the burden which they impose upon others upon the lowest basis, namely, the financial, we find that it now costs £30 a year to educate a feeble-minded child in a special school as against £12 a year in the case of a normal child.

Whether or not the persons exhibiting these grave deficiencies are increasing in number, it appears desirable on all grounds that they should ultimately disappear from the population. How can this result be brought about? No one now desires to see selection in the old form brought in again. On the contrary, it is the firm intention of all inhabitants of civilised countries to see that every possible measure is taken to alleviate the lot of those who in any way are less well endowed than their neighbours. But the provision of the best treatment and surroundings that modern knowledge can give does not of necessity carry with it liberty to have children. The solution must be found by restricting the right to produce offspring.

Steps in this direction have been taken in various countries. In England there is no restriction upon marriage on account of inherited mental defect. In view, however, of the difficulties which are often felt regarding proposals to restrict the right to marry on these grounds, it is well to remember that the principle of restricting the right to marry is not unknown in this country. Those below a certain age or those falling within a certain degree of blood relationship may not marry. In Germany it has been suggested that intending couples should be obliged to present themselves before a registrar a certain number of weeks before marriage. He would hand them a pamphlet issued by the Government

setting out certain elementary biological facts and advising that before marriage is contracted medical advice should be sought under certain circumstances. In other countries, such as Austria, voluntary associations give similar advice to intending couples. These schemes aim at arousing a conscience in these matters and at providing access to knowledge whereby the conscientious may be guided in their actions. Clearly enough these schemes will not touch those in whom no sense of responsibility exists or can be aroused.

Further steps have been taken in America. Marriage laws come within the province of the State legislatures, and great diversity exists in respect of marriage legislation as between one State and another. In several States marriage has been made illegal on account of one or more of the following conditions: insanity, feeble-mindedness, epilepsy, criminality and alcoholism. Whether or not alcoholism and criminality are to any considerable extent connected with inherited qualities, it is clear that the intention is to prevent persons exhibiting various kinds of innate deficiency from marrying. In some other countries similar steps have been taken; in Russia, for example, mental deficiency is a bar to marriage. The existence of these laws cannot make the production of offspring impossible by those to whom marriage is illegal. Since, however, contravention of these laws is punished by imprisonment, the system, if

strictly enforced, would render those persons exhibiting the scheduled defects very much less fertile than they would otherwise be.

Defectives are under certain circumstances segregated in institutions in many countries and while under care cannot reproduce their kind. It would appear that segregation has never been undertaken with the object of preventing those segregated from having children. Segregation is used to ensure the safety of the defectives and of others. But it would seem to be possible to employ segregation in cases where those to whom marriage was not permitted were found to have had children.

Sterilisation is another method whereby those exhibiting defects may be rendered incapable of reproduction. Sterilisation can be achieved by a simple operation in the case of the male and by a rather more serious operation in the case of the female. In 1921 fifteen States in America had passed laws on the subject of sterilisation. In five of these States the validity of the laws had been questioned and in consequence they were not functioning. In the remaining ten States the laws could be put in operation even if they were not in fact functioning. The provisions vary greatly from State to State. In general it may be said that they make legal the compulsory sterilisation of particular grades of defectives in certain State institutions, and they sometimes permit sterilisation to be

ordered by a court in the cases of certain classes of persons who are convicted of certain offences. It will be observed that sterilisation is not performed upon any defectives of particular grades, but only upon those who happen to be found in particular State institutions. Up to January 1921, 2233 persons had been sterilised in America in accordance with these laws. Insane, feeble-minded and criminal persons had been treated, but operations had not up to that time been performed upon alcoholic, diseased or physically defective persons.

It is evident that by some such provisions as these not only could the increase of persons with particular defects be stopped, but the strains bearing these defects might in time be eliminated altogether from the population. The following questions may be asked. To whom should apply such regulations as may be made? Is there not a danger that valuable qualities will be lost altogether with the defects? How long would elimination take? Let us consider these points.

There is evidence that poor physique is not correlated with good mental endowments. It would thus appear that the elimination of physical defects would at least not damage the mental endowment of the race. It is frequently suggested, and sometimes definitely stated, that certain very desirable mental qualities are often accompanied by epilepsy and other mental disorders. In particular it

has been widely held that outstanding genius has often been accompanied by mental disorders. Mr. Havelock Ellis has finally disposed of this assumption by a simple appeal to facts. He has shown, for instance, that there is no evidence that either Julius Cæsar or Napoleon or any other outstanding man of genius was epileptic, with the possible exception of Dostoevski, in whose case the defect may have been induced and not inherited. It has been definitely shown, on the other hand, that special abilities are correlated with high general intelligence. The evidence is therefore to the effect that the elimination of mental defect would raise and not lower the average mental capacities of the race. And it is the net effect which alone is relevant; the occasional production of a gifted person from a defective stock, which is theoretically possible as a rare phenomenon, cannot compensate for prevalence of defect, especially when it is remembered that by eliminating defect and raising the average mental endowment we are making the appearance of highly gifted persons far more likely.

It is a most difficult matter to decide what defects are so grave that efforts should be made to eliminate them. It seems clear that there are certain physical defects, hereditary blindness, for instance, and certain mental defects, idiocy, for example, so grave that efforts to eliminate them might meet with general approval even now. How much

further and in what directions it might be desirable later to proceed will be a matter for the most careful discussion. It is clear that great difficulty will be experienced when it is attempted to draw the line between defects and to lay down that the exhibition of certain defects renders a man an undesirable parent. The difficulty arises because, while defects are more often than not continuous, the treatment is, so to say, discontinuous. There is every grade of dental defect down to complete toothlessness. It might be admitted that toothlessness was a defect so grave that the innately toothless should not have offspring. But at what point should we draw the line? The point must be an arbitrary one involving some apparent unfairness for those who fall just below the line agreed upon. But great as this difficulty is, it is one that arises in many spheres of social administration. Anti-social actions, for example, pass from the trivial to the serious by a series of gradations, but at some arbitrary point actions are punished by imprisonment, unfair as this may appear to be to those who just escape imprisonment although their offence may have been almost as serious as that committed by persons imprisoned.

Finally, how long would these methods have to be practised before any serious reduction in the prevalence of a defect was achieved? There is an impression abroad that the process would be a very slow one. Fortunately this

impression is erroneous. The result upon future generations of preventing those exhibiting defects of any kind from reproducing depends upon the mode of inheritance of the defect. Let us take the case of a defect which is inherited as a simple recessive; there is, as has been seen, some evidence that mental defect is so inherited. Let us also suppose that mating is at random. These suppositions, it should be noticed, are unfavourable to the effectiveness of selection. It has been shown by Mr. Fisher that on these assumptions, if those showing the defect in each generation were not allowed to have children, the reduction, starting with 100 defectives in 10,000, would be to 89·6 in the first generation, to 69·4 in the second generation, and to 59·2 in the third generation. These methods can therefore achieve a very substantial reduction in a comparatively short period of time.

The circumstances assumed are more unfavourable to selection than those which actually exist. Not all defects are recessive and mating is not at random. Assortative mating is the rule; mentally deficient persons tend to marry persons similarly afflicted. Mental deficiency is as a result concentrated in certain stocks. It follows that the results which could be achieved by prohibiting propagation among the feeble-minded are correspondingly greater. The reductions mentioned above are considerably less than those which might be brought about.

Enough is known about the cessation of selection and its consequences to justify the taking of steps somewhat upon the lines indicated above. Our knowledge of differential fertility is also sufficient to justify attempts to counteract the undesirable effects which follow from it. A second field where immediate steps are desirable is here opened up. In the seventh chapter a brief analysis was given of the causes of differential fertility, and some further consideration of them will indicate some possible methods of reform.

Knowledge of contraceptive methods is not equally disseminated throughout the population. The "upper" classes are in general better acquainted with these methods than are the "lower" classes. The use of these methods may or may not be desirable; that problem does not arise here. The important fact for our purpose is, that so long as all sections of the population have not equal access to these methods, the birth-rate of those sections well acquainted with these methods will tend to be lower than that of other sections not so well informed. Unless these methods are to be wholly condemned, the spreading of this knowledge among the "lower" classes is to be welcomed, and the efforts now being made to bring this knowledge equally at the disposal of all should meet with the support of those who wish to see the effective fertilities of the different

sections of the population becoming less strongly contrasted.

The raising of the dignity and status of women by better education, by the opening of professions to them, by increasing opportunities for useful occupations outside the home, tend to reduce the birth-rate. The position of women has been far more changed in some sections of the population than in others. As in one way or another the position of women is enhanced in those sections where it is still low, the fertility of these sections will tend to decline. The effect of higher education upon the fertility of women is very considerable, and it is sometimes thought that the making of education of women among the more prosperous classes more general will continue to cause a reduction of fertility sufficient to set off any reduction that may be taking place in the birth-rate of the less prosperous classes. It is therefore satisfactory to note that there is some evidence from America to the effect that among the later generations of women graduates there is a higher proportion of marriages than among the earlier generations. It may therefore be that the raising of the status of women does not after a time continue to reduce fertility, in which case this movement will tend to equalise the fertility of the different sections and not to reduce it proportionately.

The members of the more prosperous sections of society have more or less clearly

in mind a standard of living to which they think themselves entitled. They strive to maintain this standard and to raise it. The existence of such a standard seems to act somewhat in the following manner. When the money income remains the same and prices rise, the standard is maintained by having a smaller family; when prices fall, the family is not increased and the standard is raised. In general the existence of a standard keeps the birth-rate down. While the less prosperous sections have also a standard, as appears from the refusal to accept cheaper substitutes for food to which they are accustomed, and from the efforts made to keep up the "standard rate," the result does not work out quite in this way. Though children are a burden while below or of school age, they are not a continuing burden, and in fact are often an asset. Again, industrial and social conditions are such as to favour early marriage.

It is not infrequently suggested in some quarters that a remedy is to be found in the reversal of the policy of subsidising the poor out of the pockets of the well-to-do. Those who use phrases of this kind are thinking of such services as education and old age pensions, the money to pay for which comes chiefly from the taxation levied on the rich, and the benefits derived from which are chiefly received by the poor. It is supposed that those who now groan under this taxation would, if relieved from it, have larger families, while those who

would be deprived of the benefits now freely received would be induced to limit their children in order that they might save money for their old age and provide for themselves what they now get without payment.

It is well to note that the vague phrases often used in this connection suggest that a much larger sum is transferred from rich to poor than is, in fact, the case. In the year ending 31st March, 1923, the total amount spent out of money provided by local rates and by parliamentary votes and grants on all forms of social service in Great Britain was approximately £264 millions. Of this sum in round figures £76 millions was spent on war pensions, £84 millions on education and £44 millions on Poor Law services, leaving some £60 millions for old age pensions, insurance in all forms, maternity and child welfare, and the administration of the Mental Deficiency Act. During the same period £324 millions went in the service of the National Debt. The use of loose phrases suggesting that very large sums of money are being taken from the rich and used to provide services which the poor could provide for themselves is thus not justified by the facts.

Apart, however, from the amount transferred, what results might be expected to follow a change of policy such as is recommended? Except in the case of some hard-pressed professional families there is no reason to think that the more prosperous classes if

relieved of taxation would have more children. The usual result of a rise of salary is a larger house, more servants, a motor-car—anything rather than more children. Millionaires, who cannot even under the present rate of taxation be regarded by any stretch of the imagination as lacking in means to educate and provide for the largest family, are not remarkable for the large size of their families. There is also no reason to think that the poor would have smaller families. The lower the standard of living within a man's grasp the less foresight and self-restraint he is likely to exhibit at the moment. He thinks, as Dr. Johnson said, "I cannot be worse, so I'll e'en take Peggy."

M. March has published the following table, which throws light upon our problem. The employees and workmen for whom particulars are given were in the service of the French Government and of French local authorities. The table shows the number of children born in every hundred families.

NUMBER OF CHILDREN BORN PER HUNDRED FAMILIES.

(Duration of marriage, 15–25 years.)

	(Income in £.)							
	Less than 20.	20 to 40.	40 to 60.	60 to 100.	100 to 160.	160 to 240.	240 to 400.	More than 400.
Employees .	277	241	259	245	223	231	229	238
Workmen .	329	321	293	280	254	234	—	—

The table brings out two facts. The higher the occupation in the social scale the smaller the family; the better the remuneration within any grade in the scale the smaller the family. Larger incomes for employees and smaller incomes for workmen would therefore tend to increase and not diminish the difference between the fertilities of the two classes.

The fallacy of supposing that differential fertility can be diminished by lightening the burden on the rich is evident if the effect of adopting precisely the opposite policy is examined. Under a communistic régime, where all received the same income, with allowances to enable men to fulfil their special functions—tools for workmen and instruments and means of transport for doctors—differential fertility would vanish except in so far as it arose from causes other than the social and economic causes that we are examining. What then can be done short of taking steps towards the establishment of communism? There are two main lines of advance. The raising of the standard of living of the less prosperous classes, and a revision of the dominant conceptions of social values. An increase in the standard of living would not merely imply a greater money income, but better conditions, such as secondary education for all. Under these circumstances not only would the poorer parents have more incentives to limit their families, but the position of their children

would be less unlike that of the children of richer parents, and the young people in the country would not be so strongly contrasted as they now are in respect of the positions in which they stand towards the desirability and even possibility of marriage at early ages. By the raising of social values is implied that expenditure upon pure luxuries and ostentation should give place to expenditure upon objects and actions of social value, and among the latter is the bringing up and care for children.

Differential fertility, unlike the problems arising from the cessation of selection, cannot be directly dealt with by legislation. Legislation can indirectly assist in remedying the present position. But it is rather to a change of attitude towards social duties and obligations that we must look for a remedy of a state of things which, it may be noted, is not merely racially injurious but also socially injurious. The failure of the professional classes to reproduce in proportion to their numbers, whatever it may imply racially, also implies that less children are brought up in the traditions of the professional classes than are required in order to take the places of their parents, and more are brought up in the traditions of the manual labour class than are required for work of that nature.

Some reference has been made as to possible solutions of certain problems which face every civilised country. Some countries have

additional problems, as, for instance, those arising from the presence of alien racial stocks. The world as a whole is faced with problems arising from the varying rates of increase of different racial groups. These problems cannot be taken up here. One observation may, however, be made. This country is in an unusually favourable position as compared with many civilised countries. The proportion that the inhabitants of Germany and France bear to the total population of the world is likely to sink when, as is inevitable, other countries now industrially backward adopt modern methods of production. The same fate awaits the inhabitants of this island in one sense. But for men of our race there is a way of escape not open to the inhabitants of any other European country. It is possible for men of our race to people Canada, Australia and New Zealand until, as is not yet the case, they are relatively full. If this comes about, as is earnestly to be hoped, men of our race as a whole will come to form a much larger proportion of the total inhabitants of the world than they do now.

More space has been devoted in this book to the science than to the art of eugenics. In the eye of the public the art occupies the greater place. But the art cannot progress until the science has made further progress. It is to the development of the science that our efforts should be directed. The advocacy of measures based on insufficient data and

inaccurate deductions from them do more harm than good. The problems are pressing, but no apprehension need be felt that, when scientific investigation has shown what the facts are, action will not be taken. Science is now so firmly established that obscurantism will not again prevail against it. In the sphere of politics the appeal is slowly but surely more and more to facts. The emotional rhetorician gets less and less of a hearing. And there is every hope that when the facts are made plain for all to see, action will be taken guided by the dictates of a wise social philosophy.

NOTE ON BOOKS

THOSE who have no previous acquaintance with modern studies of heredity are strongly advised to read an elementary text-book such as Doncaster's *Heredity*, which may be followed by Crew's *Animal Genetics*. Castle's *Genetics and Eugenics* and Conklin's *Heredity and Environment* deal with heredity and the biological background, and also to some extent with the application of this knowledge to human problems. Lloyd Morgan's *Eugenics and Environment* is a valuable treatment of the problem of heredity and environment. *Living Organisms*, by Goodrich, is an admirable account of the present position of the theory of evolution. For information regarding inheritance in man *Heredity and Eugenics*, by Ruggles Gates, and *Grundriss der menschlichen Erblichkeitslehre und Rassenhygiene*, by Baur, Fischer and Lenz, may be consulted.

Among recent books dealing with the present position of eugenic studies Popenhoe and Johnson's *Applied Eugenics* is probably the most useful. The following may also be mentioned: Holmes, *The Trend of the Race* and *Evolution and Eugenics;* Schuster, *Eugenics;* Davenport, *Heredity in Relation to Eugenics.* Several chapters in Havelock Ellis's *Essays in War-time* deal with important aspects of eugenics. Galton's work should be studied by all those interested in the subject, especially his *Essays in Eugenics*, *Hereditary Genius* and *Inquiries into Human Faculty.* The latter contains an account of his investigation of identical twins. The reports of the First and Second International Eugenic Congresses have been published under the titles of *Problems in Eugenics*, *Eugenics, Genetics and the Family*, and *Eugenics in Race and*

State. Reference may be made to the following books for information as to the bearing of heredity upon certain social problems: Goring, *The English Convict;* Burt, *The Young Delinquent;* Tredgold, *Mental Deficiency;* Laughlin, *Eugenical Sterilisation in the United States of America.*

Among serial publications the *Eugenics Review,* published by the Eugenics Education Society in England, and the *Eugenical News,* published by the Eugenics Record Office in America, contain articles and news of general interest. Among the more strictly scientific publications the *Archiv für Rassen- und Gesellschaftsbiologie* is especially valuable. *Biometrika* contains a number of statistical studies of eugenic problems. The publications of the *Galton Eugenics Laboratory* in London and of the *Eugenics Record Office* in America include numerous memoirs of great value and importance to specialists. *A Bibliography of Eugenics* has been published by S. J. Holmes.

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INDEX

Acquired characters, inheritance of, 45
Alcohol, 71
Alcoholism, 150, 184
Assortative mating, 197

Backward children, 183
Barrington, Miss, 86
Burt, Mr. Cyril, 97, 131

Campanella, 23
Cancer, inheritance of, 70
Chromosomes, 33
Correlation coefficient, 58
Crime, 142, 184

Darwin, Charles, 24, 25
Disease, inheritance of, 68
—— selective effect of, 188

Eye colour, 56
Eyesight, 86

Feeble-mindedness, 54, 66
Fertility, differential, 170, 217
Fisher, Mr. R. A., 89, 243

Galton, Sir F., 24
Gametes, 32
Genes, 35
Germ cells, 32
Goring, Dr., 142

Hill, Dr. Leonard, 91

Inbreeding, 73
Industrialism, 194
Infant mortality, 185
Insanity, 178
Intelligence, 97, 131

Maternal impressions, 72
Mendel, 29
Mental deficiency, 178, 243
Mutation, 43, 70, 211

Negroes, 120

Outbreeding, 73

Pauperism, 159, 184
Pearson, Professor K., 26, 59, 86, 102, 184
Physique, 123
Plato, 23
Preferential mating, 198
Pre-natal mortality, 185

Racial differences, 118

"Racial poisons," 70
Religion, 192
Restriction of marriage, 238
Reversion, 39

Segregation of defectives, 239
Sexual reproduction, 31
Sterilisation, 239
Stevenson, Dr., 170
Syphilis, 69

Theognis, 22
Tuberculosis, 216
Twins, 102

Unemployment, 153, 184
Urbanisation, 194

War, 189

Zygotes, 32

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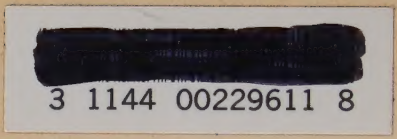
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